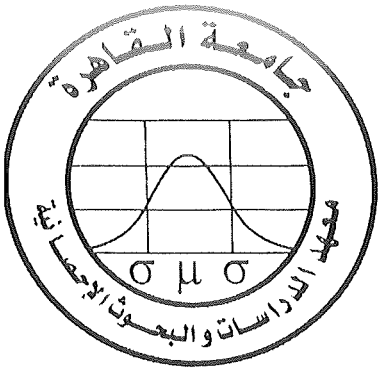

جامعة القاهرة

معهد الدراسات والبحوث الإحصائية

المؤتمر السنوى التاسع والأربعون للإحصاء وعلوم الحاسب وبحوث العمليات

مجلد

احصاء سكانى

٢٢-٢٥ديسمبر ٢٠١٤

فهرس الإحصاء السكانى

العوامل المحددة للإصابة بالالتهاب الكبدي الفيروسي (C) في مصرعام ٢٠٠٨

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١- مقدمة

يعتبر فيروس (C) أخطر الفيروسات انتشارا ، حيث يشكل أحد أهم التهديدات إلي تتعرض لها الأوضاع الصحية في أي مجتمع إذ أنه يعتبر الوباء العالمي القادم ، ويوصف هذا الوباء بالوباء الصامت حيث أنه يظل مجهولاً بشكل نسبي وعادة يتم تشخيصه في مراحله المزمنة عندما يتسبب بمرض كبدي شديد .

وتشير الإحصاءات الطبية أشارت إلي أن حوالي ٣ % من سكان العالم أي مايقدر نحو ١٧٠ مليون شخصاً يعانون من الإصابة بمرض صامت يقوم بتدمير الكبد ، وغالباً ما يجهل الشخص المريض إصابته بالمرض وذلك نتيجة إلي أن حوالي ٩٠ % من المرضي المصابين بالالتهاب الكبدي الفيروسي (C) لا يظهر لديهم أي أعراض للمرض ولا يدركون أصابتهم بالمرض إلا بعد مرور أعوام طويلة من الإصابة وتلف الكبد بشكل كبير جداً وعدم قيامه بوظيفته كما أن المريض يمكن أن يكتشف إصابته بذلك المرض مبكراً في بعض الأحيان وذلك في حالة قيامه بالتبرع بالدم حيث يتم اكتشافه عن طريق فحص الدم قبل التبرع وأيضاً يمكن أن يكتشف في حالة السفر عند قيام المسافر بإجراء تحليل فيروس C (تقرير علم الأوبئة ، ٢٠٠٢) ، (منظمة الصحة العالمية ، ٢٠١٢)

تواجه مصر في الوقت الحالي مشكلة في الإصابة بالفيروسات الكبدية خاصة وأن نسبة الإصابة ليست قليلة مع أنها تناقصت بعض الشيء مع بعض برامج الوقاية إلا أن نسبة الإصابة بالفيروس (C) تظل مشكلة خطيرة خاصة أن معظمها يحدث نتيجة ممارسات طبية أو مجتمعية خاطئة.

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٢- مشكلة البحث

تسجل مصر أعلى معدل لانتشار الالتهاب الكبدي الفيروسي(C) في العالم حيث يسجل حوالي ١٥% عام ٢٠٠٨ (المسح الديموجرافي الصحي ٢٠٠٨) في فئة العمر ١٥- ٥٩ سنة ، ويمكن أن يستغرق الأمر ما بين ٢٠ إلى ٣٠ عاما من الإصابة بفيروس التهاب الكبد (C) قبل ان يعاني المرضى من مضاعفات خطيرة. لذلك فإن أسوأ الآثار الناجمة عن هذا الوباء ستظهر خلال السنوات القليلة المقبلة وتتمثل مشكلة البحث في الأتي :

عدم معرفة المتغيرات الديموجرافية والاجتماعية والاقتصادية والصحية المحددة للإصابة بالالتهاب الكبدي الفيروسي (C) حتي يمكن تجنب ما من شأنه التأثير علي الحالة الصحية وتقليل أخطار الإصابة بذلك الفيروس.

٣- هدف البحث

يهدف البحث إلي التعرف علي المتغيرات الديموجرافية والاجتماعية والاقتصادية والصحية المحددة في مصر علي الإصابة بالالتهاب الكبدي الفيروسي (C).

٤- فروض البحث

- إنخفاض الإصابة في الأعمار الصغري ومرتفعة في الأعمار الكبري .
- إن الذكور أكثر عرضة للإصابة بالالتهاب الكبدي الفيروس (C) .
- كلما ارتفع مستوي التعليم كلما انخفضت نسب الاصابة بذلك الفيروس نتيجة تضاؤل فرص القيام بتصرفات أو سلوكيات ضارة.
- ارتفاع معدلات الإصابة بالاتهاب الفيروس (C) بالمناطق الريفية عن الحضرية.
- وجود علاقة عكسية بين الثروة والإصابة بذلك الفيروس .
- ارتفاع معدلات الإصابة بالاتهاب الفيروس (C) للذين تم علاجهم من مرض البلهارسيا قبل وأثناء الثمانينات (القرن العشرين)
- أن نقل الدم من شخص مصاب بالفيروس (C) إلي شخص غير مصاب سوف يكون له تأثير بنقل الاصابة إلي الشخص غير المصاب بذلك الفيروس .
- ارتفاع نسب الاصابة بالفيروس للذين أجرو عمليات جراحية .
- إن الختان الذي يتم علي يد حلاق له تأير علي الإصابة بذلك الفيروس .

٥- الدراسات السابقة

يتناول هذا الجزء أهم الدراسات السابقة للعوامل الديموجرافية والاجتماعية والاقتصادية والصحية المحددة للإصابة بالالتهاب الكبدي الفيروسي (C) :

- (أحمد السيد ، ٢٠٠٥) تهدف الدراسة إلي تقييم مدي تأثر الكبد في المرضي المصابين بالالتهاب الكبدي الوبائي الفيروسي (C) المزمن ، وقد بينت النتائج وجود فروق ذات قيمة إحصائية بين متوسط العمر ودرجة ومرحلة التليف بالكبد في المرضي المصابين بالالتهاب الكبدي الفيروسي (C) المزمن ، وتبين وجود فروق ذات قيمة إحصائية بين متوسط عدد الصفائح الدموية في الدم ودرجة ومرحلة التليف بالكبد في المرضي المصابين بالالتهاب الكبدي الفيروسي (C) المزمن ، وتبن عدم وجود فروق ذات قيمة إحصائية بين نسبة أنزيم الكبد (AST,AST) ودرجة ومرحلة التليف بالكبد في المرضي المصابين بالالتهاب الكبدي الفيروسي (C) المزمن .

- عن دراسة (نشوي ، أبو الفتوح ، ٢٠٠٧) ، " الآثار النفسية والاجتماعية للمريض المصاب بالالتهاب الكبدي الفيروسي من النوع (C) " ، قد أوضحت النتائج أن الالتهاب الكبدي الفيروسي من النوع (C) يؤثر بطريقة ما علي جميع القياسات النفسية للمريض ومن هنا لابد من الاهتمام بالجانب النفسي والاجتماعي للمريض وتدريب أطباء الكبد علي كيفية التعامل مع هذه الاضطرابات ومحاولة علاجها .

- بينت دراسة(ج. توماس ستريكلاند ، ٢٠٠٦) " البلهارسيا من أهم مشاكل الصحة العامة في مصر – وتعتبر البلهارسيا السبب الرئيسي لأمراض الكبد " ، أنه منذ عام ١٩٥٠ تجري وزارة الصحة المصرية حملات مكافحة واسعة موحدة لمرض البلهارسيا ، والعلاج علي نطاق المجتمع المحلي ، وإن المجهود الجدير بالثناء للتحكم في المشكلة الصحية الخطيرة كان للأسف منشأ لكارثة وهي فيروس (C) ، ولا سيما داخل الأسر في المناطق الريفية والمتوطن فيها البلهارسيا حيث أن من ٧٠% إلي ٩٠% من المرضي الذين يعانون من التهاب الكبد المزمن وتليف الكبد أو سرطان الكبد والتهابات الكبد الوبائي كانت مشتركة مع البلهارسيا أكثر شدة بمرض الكبد من الإصابة بفيروس (C) وحدها ، كما أن مضاعفات التهاب الكبد (C) عادة ما تحدث بعد ٢٠ سنة من الإصابة ، وعلي الرغم من الجهود التي بذلت من قبل وزارة الصحة المصرية لمنع حدوث إصابات جديدة ومضاعفات هذا الفيروس في الأشخاص إلا أنه تقدر الإصابة بحوالي ٦ مليون شخص .

- كما تبين من دراسة (الزناتي ، وآخرون ، ٢٠٠٨) " الجوانب الصحية " أن نسبة المصابين بالالتهاب الكبدي الوبائي فيروس (C) تمثل حوالي ١٤.٧ % للعمر من (١٥ – ٥٩ سنة) ، وأن حوالي١٥ % من إجمالي عينة المسح الذين أجروا اختبار الأجسام المضادة (HCV) كانت نتيجتهم إيجابية وهذا يعني أنهم حاملين لفيروس الالتهاب الكبدي الوبائي (c) ومن بينهم حوالي ١٠ % حاملين لفيروس (c) وفي حالة نشطة (HCV-RNA) الذي يعبر عن الحمض النووي للفيروس وهو ناتج من تحليل PCR في عينة الدم ، كما تبين أن من بين الذين لديهم نتيجة إيجابية للأجسام المضادة (HCV) حوالي١٠ % يقيمون بالحضر في حين بلغت نسبتهم في الريف ١٨ % .

٦- منهجية البحث

تعتمد منهجية البحث علي استخدام تحليل الانحدار اللوجيستي **Logistic Regression** حيث أن الانحدار اللوجستي هو نموذج يستخدم للتنبؤ باحتمالية وقوع حدث ما وذلك بملائمة البيانات على منحنى لوجستي ، يستخدم الانحدارُ اللوجستي عدة متغيرات مُتوقَّعة والتي يمكن أن تكون رقمية أو فئوية ، فهو يُستخدم بشكل واسع في الطب والعلوم الاجتماعية ، الانحدار اللوجستي هو أحد عناصر مجموعة من النماذج تسمى بمجموعة النماذج الخطية العامة وهي بدورها تلك النماذج التي يتم إعدادها بغرض أظهار المتغيرات التي تؤثر علي الإصابة بالتهاب الكبدي الفيروسي (C) .

يطبق اسلوب الانحدار اللوجيستي عندما يكون المتغير التابع (Y) هو متغير وصفي ثنائي يتبع توزيع بيرنولي ثنائي Bernolli ويأخذ القيمة (١) باحتمال (p) والقيمة (0) باحتمال (1-p) =q وتأخذ متغيراته المستقلة والمتغير التابع قيماً مستمرة . ويمكن التعامل مع النموذج علي الصورة التالية:

$$\ln\left(\frac{p}{1-p}\right) = \hat{\beta}_0 + \hat{\beta}_1 \chi + \hat{\beta}_2 \chi_2 + \ldots\ldots\ldots + \hat{\beta}_k \chi_k$$

حيث :

P : تشير إلي احتمال حدوث الحدث أي أن (Y = 1) P

$\left(\frac{P}{1-p}\right)$: تشير إلي نسب الترجيح Odds Ratio

$\hat{\beta}_0$: (ثابت الانحدار)

$\hat{\beta}_k$: معاملات الانحدار اللوجيستي ، وتشير إلي التغير الذي يحدث في Log odds

نتيجة لتغير المتغير المستقل بمقدار الوحدة حيث K= 1,2,... ... ..., k

x_k : المتغيرات المستقلة

٧- مصادر البيانات

بيانات المسح الديموجرافي الصحي لمصر ٢٠٠٨ حيث يعتبر مصدراً هاماً للبيانات التي تحتاجها الدراسة حيث أنهما من أنسب البيانات المتاحة من سلسلة المسوح .

ويبلغ حجم العينة (١١.١٢٦) منها (١.٦٣٦) مصاب / مصابة بالالتهاب الكبدي الفيروسي (C) أي بنسبة ١٥% تقريباً وتلك البيانات سيعتمد عليها في التعرف علي المتغيرات التي تؤثر في الإصابة بذلك المرض ، والأهمية النسبية لكل من تلك المتغيرات .

٨- المتغيرات الديموجرافية والاجتماعية والاقتصادية والصحية المحددة للاصابة بالالتهاب الكبدي الفيروسي (C) باستخدام نموذج الانحدار اللوجيستي logistic regression

إن للإصابة بالمرض تأثيراته الصحية والمتمثلة في أنه يعتبر قنبلة موقوتة تنشر شظاياها بين أفراد الأسرة بصفة خاصة والمجتمع بصفة عامة ، وإن تدني الخدمات الصحية والعوامل السلوكية يؤدي إلي ظهور حالات جديدة للإصابة بهذا المرض .

جدول رقم (١)

توزيع عينة أفراد الأسر المعيشية "الجوانب الصحية "

حسب المصابين وغير المصابين عام ٢٠٠٨ م

المتغيرات	العدد	النسبة
المصابين	1636	%15
غير المصابين	9490	%85
إجمالي	11126	%100

- مصدر البيانات: تقرير المسح الديموجرافي الصحي ٢٠٠٨

لتحديد التأثير الصافي لكل متغير في ظاهرة الإصابة بذلك الفيروس وقياس الوزن النسبي مع الأخذ في الاعتبار تأثير المتغيرات الأخرى وذلك باستخدام نموذج الانحدار اللوجيستي logistic regression

تم الاعتماد علي ثلاثة أبعاد للوصول لأفضل تفسير لاحتمال الاصابة بالالتهاب الكبدي الفيروسي (C):

١- تحديد أهم المتغيرات من الناحية العلمية التي تفسر الاصابة بالالتهاب الكبدي الفيروسي (C)

٢- مستوي المعنوية الاحصائية لكل متغير .

٣- كيفية قياس المتغيرات بحيث تعطي أفضل وصف لها في علاقتها بظاهرة الاصابة بالالتهاب الكبدي الفيروسي (C) .

قد تم تحديد مجموعة من المتغيرات (الديموجرافية والاجتماعية والاقتصادية والصحية) التي تم اختيارها من بيانات المسح الديموجرافي الصحي ٢٠٠٨ لتطبيق نموذج الانحدار اللوجيستي عندما يكون المتغير التابع (Y) وصفي ثنائي ويأخذ القيمة (صفر ، ١) ويتبع المنحني اللوجيستي ، للتنبؤ باحتمالية وقوع حدث الإصابة بالالتهاب الكبدي الفيروسي (C) وذلك بملاءمة البيانات على منحنى لوجستي ، يستخدم الانحدار اللوجستي عدة متغيرات (الديموجرافية والاجتماعية والاقتصادية والصحية) والتي يمكن أن تكون رقمية أو فئوية .

وفيما يلي نعرض قائمة بالمتغيرات المستخدمة وكود كل منها والفئة المرجعية لكل متغير :

جدول (٢)

أهم المتغيرات المستخدمة لتفسير حالات الاصابة بالالتهاب الكبدي الفيروسي (C)

	اسم المتغير	الكود	الفئات المرجعية	
المتغير التابع				
Y	الاصابة بالالتهاب الكبدي الفيروسي (C)	0	غير مصاب	(الفئة المرجعية)
		1	مصاب	
المتغيرات المستقلة				
١- المتغيرات الديموجرافية والاجتماعية				
χ_1	العمـــــــر	1	من ١٥-٢٤	(الفئة المرجعية)
		2	من ٢٥-٣٤	
		3	من ٣٥-٤٤	
		4	٤٥+	
χ_2	النـــــــوع	0	أنثي	(الفئة المرجعية)
		1	ذكر	
χ_3	الحالة الزواجية	0	غير متزوج	(الفئة المرجعية)
		1	متزوج	
χ_4	الحالة التعليمية	1	أمي	(الفئة المرجعية)
		2	ابتدائي	
		3	إعدادي / ثانوي	
		4	عالي	
χ_5	المناطق الجغرافية	1	محافظات حضرية	(الفئة المرجعية)
		2	حضر بحري	
		3	ريف بحري	
		4	حضر قبلي	
		5	ريف قبلي	
		6	الحدود	
χ_6	المعرفة عن الالتهاب الفيروسي (C)	0	يعرف	(الفئة المرجعية)
		1	لا يعرف	

تابع جدول (٢)

أهم المتغيرات المستخدمة لتفسير حالات الاصابة بالالتهاب الكبدي الفيروسي (C)

اسم المتغير		الكود	الفئات المرجعية	
٢- المتغيرات الإقتصادية				
χ_7	الحالة العملية	0 1	لا يعمل بعائد نقدي يعمل بعائد نقدي	(الفئة المرجعية)
χ_8	مؤشر الثروة	1 2 3	المستوي المنخفض المستوي المتوسط المستوي المرتفع	(الفئة المرجعية)
٣- المتغيرات الصحية				
χ_9	علاج البلهارسيا بالحقن	0 1	لا نعم	(الفئة المرجعية)
χ_{10}	التعرض لنقل الدم	0 1	لا نعم	(الفئة المرجعية)
χ_{11}	التعرض للصفراء	0 1	لا نعم	(الفئة المرجعية)
χ_{12}	الوخز بسن أبرة مستعملة سابقاً	0 1	لا نعم	(الفئة المرجعية)
χ_{13}	الحقن بسبب آخر غير البلهارسيا	0 1	لا نعم	(الفئة المرجعية)
χ_{14}	التعرض لعمليات جراحية	0 1	لا نعم	(الفئة المرجعية)
χ_{15}	التعرض لعلاج للأسنان	0 1	لا نعم	(الفئة المرجعية)

ولدراسة الأثر الصافي لكل متغير قد تم بناء واختبار عديد من النماذج ، وقد خلصت الدراسة إلي أفضل نموذج يتم من خلاله التعرف علي محددات الإصابة بالالتهاب الفيروسي (C) ومن نتائج الجدول التالي (٣) الذي يشير إلي نتائج تحليل الانحدار اللوجيستي لقياس تأثير بعض المتغيرات علي الإصابة بالالتهاب الفيروسي (C) وذلك من بيانات المسح الديموجرافي الصحي عام ٢٠٠٨ ، تبين أن النموذج جوهري إحصائياً من حيث جودة توفيق النموذج Goodness of Fit عند قيمة P-value < 0.001 وأتضح قدرة العوامل الداخلة في النموذج علي التفسير بنسبة ٨٦% ، كما وأنه تبين وجود متغيرات معنوية إحصائياً عند قيمة P-value ≤ 0.001 ، ومتغيرات أخري معنوية إحصائياً عن قيمة P-value < 0.05 .

جدول (٣)

تأثير بعض المتغيرات علي الاصابة بالالتهاب الكبدي الفيروسي (C)

	المتغيرات المستقلة	معامل الإنحدار B	مستوي المعنوية Sig.	نسبة الترجيح Odds Ratio
1	العمر			
	- من ٢٥-٣٤ سنة	0.329	0.008	1.390
	- من ٣٥-٤٤ سنة	1.053	0.000	2.865
	- ٤٥ سنة فاكثر	1.918	0.000	6.806
2	النوع			
	ذكر	0.459	0.000	1.593
3	الحالة الزواجية			
	متزوج / متزوجة	0.353	0.003	1.423
4	التعليم			
	- اعدادي	0.289	0.000	1.335
	- ثانوي وعالي	0.145	0.082	1. 158
5	المناطق الجغرافية			
	- حضر بحري	0.182	0.169	1.200
	- ريف بحري	0.838	0.000	2.314
	- حضر قبلي	0.124	0.322	1.135
	- ريف قبلي	0.603	0.000	1.837
	- الحدود	-1.059	0.000	0.349

تابع جدول (٣)

تأثير بعض المتغيرات علي الاصابة بالالتهاب الكبدي الفيروسي (C)

	المتغيرات المستقلة	معامل الإنحدار B	مستوي المعنوية Sig.	نسبة الترجيح Odds Ratio
6	المعرفة بالالتهاب الكبدي الفيروسي (c) يعرف	-0.119	0.131	0.888
7	العمل يعمل بعائد نقدي	0.049	0.570	1.050
8	علاج البلهارسيا بالحقن سبق لهم علاج بلهارسيا بالحقن	0.416	0.000	1.515
9	نقل الدم تم نقل دم	0.295	0.020	1.342
10	تعرض للإصابة بالصفراء يتم التعرض للصفراء	0.643	0.000	1.962
11	استخدم سن حقن مستعملة سابقاً تم الاستخدام	0.291	0.042	1.352
12	علاج أسنان تم علاج للأسنان	0.044	0.480	1.045
الثـابت		-3.544	0.000	0.029
Model Chi-Square		**1413.276		
-2 Log likelihood		7918.293		

- مصدر البيانات: محسوب بمعرفة الباحثة بالاعتماد على بيانات DHS 2008 .

** مستوي معنوية عند P-value < 0.001

$$Log\left(\frac{P}{1-p}\right) = -3.544 + 0.329x_{11} + 0.459x_2 + 0.353x_3 + \ldots - 0.044x_{12}$$

$$Sig\ x^2 = 0.0000$$

٩- النتائج

يتضح من نتائج الجدول السابق رقم (٣) ما يلي :

١- احتمال حدوث الإصابة بالالتهاب الكبدي الفيروسي (C) يرتفع بتقدم العمر ، حيث أن احتمال حدوث الإصابة بذلك الفيروس في الأعمار(٢٥-٣٤ سنة) يزيد بحوالي مرة ونصف عن احتمال حدوثه في الفئة العمرية (١٥-٢٤ سنة (الفئة المرجعية)) ، ويزيد حوالي ثلاث مرات في الفئة العمرية (٣٥-٤٤ سنة) عن احتمال حدوثه في الفئة العمرية (١٥-٢٤ سنة (الفئة المرجعية)) ، ويكون له أكبر الأثر في احتمال الإصابة بذلك الفيروس في الأعمار ٤٥ سنة فأكثر بحوالي ٧ مرات عن الفئة العمرية (١٥-٢٤ سنة (الفئة المرجعية)) ، هذه الفروق معنوية عند قيمة P-value < 0.01 وذلك علي الرغم من أنه من المعروف أن العمر ليس له تأثير علي الإصابة و يمكن إرجاع ذلك إلي الاصابة بالبلهارسيا قبل وبعد الثمانينات مع عدم توافر الوعي الصحي وأيضاً أن المرض كامن لا يظهر علي الشخص المصاب إلا في مراحله الأخيره .

٢- وجود تأثير إيجابي للنوع (ذكر / أنثي) علي الإصابة بالالتهاب الكبدي الفيروسي (C) حيث يزيد احتمال الإصابة بين الذكور حوالي مرتين عن الإصابة بذلك الفيروس بين الإناث (الفئة المرجعية) ، وهذا الفرق معنوي عند قيمة P-value < 0.01 ، يمكن إرجاع ذلك إلي تعامل الذكور مع شفرات الحلاقة عند الحلاق التي من المفترض أن تكون غير معقمة .

٣- تؤكد النتائج وجود تأثير موجب للزواج علي احتمال الاصابة بالالتهاب الكبدي الفيروسي (C) فيزيد للمتزوجين بحوالي مرتين عن اللذين لم يتزوجوا (الفئة المرجعية) ، وهو فرق معنوي عند قيمة P-value < 0.01 .

٤- وجود تأثير إيجابي للحالة التعليمية علي احتمال الالتهاب الكبدي الفيروسي (C) ، حيث ينخفض احتمال الإصابة كلما ارتفع مستوي التعليم عن الأمية (الفئة المرجعية) ، وهو فرق معنوي عند قيمة P-value < 0.01 ، ويمكن إرجاع ذلك إلي تضاؤل فرص القيام بتصرفات أو سلوكيات ضارة .

٥- انتفاء التأثير الموجب لجميع المناطق الجغرافية علي حدوث احتمال الإصابة بالالتهاب الكبدي الفيروسي (C) عدا منطقة الحدود حيث ينخفض حدوث الإصابة بذلك الفيروس مقارنة بالمناطق الحضرية (الفئة المرجعية) ، ويرتفع حدوث الإصابة بذلك الفيروس

ارتفاع طفيف في حضر الوجه البحري وحضر الوجه القبلي (نسب الترجيح ١.٢٠٠ ، ١.١٣٥ علي الترتيب) مقارنة بالمناطق الحضرية (الفئة المرجعية) إلا أن الفرق بين المصابين في حضر الوجه البحري والقبلي غير معنوي ، وجدير بالذكر أن احتمال حدوث الإصابة بالالتهاب الكبدي الفيروسي (C) يرتفع في ريف الوجه البحري وريف الوجه القبلي (نسب الترجيح ٢.٣١٤ ، ١.٨٣٧) مقارنة بالمناطق الحضرية (الفئة المرجعية) وهو معنوي بريف بحري وريف قبلي عند قيمة P-value<0.01 ، ويمكن إرجاع ذلك لعدة أسباب وهي تدني مستوي الخدمات الصحية – تدني نشر ثقافة الوقاية من المرض – بعد المسافة بين القرية ومراكز الرعاية الصحية – كما وأن كفاءة الخدمة بالحضر أعلي من الريف وهذا لتوافر الامكانيات .

٦- أن احتمال الاصابة بالالتهاب الكبدي الفيروسي (C) يزيد للذين تعرضوا للحقن أثناء علاج البلهارسيا بحوالي الضعف عن اللذين لم يتعرضوا للحقن أثناء علاج البلهارسيا (الفئة المرجعية) ، وهو فرق معنوي عند قيمة P-value < 0.001 ، يمكن إرجاع ذلك لإنتقال سن الحقنة من شخص لآخر أثناء علاج البلهارسيا في الثمانينات .

٧- أن الذين تم نقل دم يزيد لديهم احتمال الاصابة بالالتهاب الكبدي الفيروسي (C) بحوالي الضعف تقريباً مقارنة باللذين لم يتعرضوا لنقل دم (الفئة المرجعية) ، وهو فرق معنوي عند قيمة P-value < 0.05 ، ويمكن إرجاع ذلك إلي نقل الدم من شخص مصاب بالفيروس (C) إلي شخص غير مصاب .

٨- إن احتمال حدوث الإصابة بالالتهاب الكبدي الفيروسي (C) للذين تعرضوا للإصابة بالصفراء يزيد مرتين عن اللذين لم يتعرضوا للإصابة بالصفراء (الفئة المرجعية) ، وهو معنوي عند قيمة P-value < 0.001 .

٩- تشير النتائج إلي أن الوخذ بسن حقنة سبق استخدامها يزيد احتمال الإصابة بالالتهاب الكبدي الفيروسي (C) بحوالي الضعف عن الذين لم يتم وخزهم بسن حقنة سبق استخدامها (الفئة المرجعية) ، وهو فرق معنوي عند قيمة P-value < 0.05

وهذا ما تؤكده دراسة بأكبر مستشفيات الشرق الأوسط وهي القصر العيني التي عدد العاملين بها ١٣.٠٠٠ وعدد الأسرة ٥١٥٠ سرير وتم الدراسة علي ١٣٦٥ شخص ٦٥٠ ذكر ، ١٢٠٤ أنثي في مختلف فئات العمر من ٢٠١٢/١ الي ٢٠١٣/٤ وتبين أن ٣١٤ شخص تعرض للوخز بالحقن منهم ٨٥ شخص مصاب بالالتهاب الكبدي

الفيروسي (C) أي ما يعادل ٦.٢٢ % وهذه نسبة مرتفعة مقارنة بمن تعرضوا لذلك الفيروس بأسباب متعددة علي مستوي مصر .

لم تؤكد الدراسة علي وجود دور معنوي لمجموعة من المتغيرات التالية علي الالتهاب الكبدي الفيروسي (C) وتشمل هذه المتغيرات : السمع عن الالتهاب الفيروس (c) علاج الأسنان ، العمل .

١٠- التوصيات

١- سلامة نقل الدم من خلال (فحص الحمض النووي واستخدام الخلايا الجزعية لحبل الدم السري) وطرق القضاء علي مسببات الأمراض في الدم ومشتقاته .

٢- ضرورة توفير بعض الأدوات الطبية المزودة بنظام الحماية ضد الوخز علي الأقل بأماكن العمليات والرعاية المركزة بالمستشفيات وإقامة دورات تدريبية متكررة للتدريب علي استخدامها .

٣- ضرورة توفير المادة الخاصة بتحليل الاختبار السريع بالمستشفيات لإثبات وجود فيروس الالتهاب الكبدي الفيروسي B في خلال ساعة من التعرض للوخز بالابر ، وتوفير التطعيم ضد الالتهاب الكبدي الفيروسي B لحماية وعلاج من يتعرض للوخز .

٤- تطبيق برامج أكثر صرامة وفعالية لإجراءات الوقاية والسلامة المتبعة في المرافق الطبية وعيادات الاسنان .

٥- تقدم دعما للعلاج وزيادة الإمكانات وتدريب طلاب كليات الطب والصيدلة والتمريض علي مكافحة العدوي.

٦- إعداد خطة اعلامية تشمل المدارس والجامعات والنوادي وخاصة المناطق الريفية عن الوقاية من الالتهاب الكبدي الفيروسي (C) .

٧- علي الدولة تركيز جهودها في المناطق الريفية وخاصة المناطق الأكثر انتشاراً لمرض الالتهاب الكبدي الفيروسي (C) .

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Table (19): Correlation between SYPE-MPI and OPHI-MPI at different cut-off points and equal weights using Spearmans's rho correlation coefficient

			SYPE-MPI at 20% Cut-off point	SYPE-MPI at 30% Cut-off point
Spearman's rho	OPHI-MPI at 20%Cut-off point	Correlation Coefficient	1.694**	
		Sig. (2-tailed)	0.000	
	OPHI-MPI at 30%Cut-off point	Correlation Coefficient		533**
		Sig. (2-tailed)		0.000
**. Correlation is significant at the 0.01 level (2-tailed).				

From the above tables, it is evidential that OPHI-MPI and SYPE-MPI are significantly correlated at 99% confidence level. However, from 20% cut-off point to at 50%, the correlation coefficient declines significantly reaching less than 0.5 with Perason's and Spearman's rho ranking coefficient. Such low correlation coefficient shows the significant difference between SYPE-MPI and OPHI-MPI indices.

It is worth mentioning that since the correlation coefficient is significantly low implying the weak robustness of the MPI indices to the change in the indicators used.

Conclusion and recommendation

The extensive robustness analysis in this paper indicates that the SYPE- MPI is significantly different in measuring the Multidimensional Poverty from OPHI-MPI with lower variance, and low correlation coefficients.

These results empirically and statistically validate the inclusion of the missing dimensions in poverty data to the global Multidimensional Poverty Index.

The usage of SYPE-MPI will in fact reflect the deprivation certain vulnerable groups actually do experience in other areas other than health, education and standard of living.

The OPHI is currently planning to adopt a household survey instrument that will cover various areas of the missing dimensions in poverty in addition to the three basic dimensions to enable collecting relevant and comparable data across all the countries. However, such step may not be acquired nor achieved soon to remain a luxury vacant only in roundtables meetings. Therefore, the researcher finds the inclusion of some of these missing dimensions to the current global MPI it quite demanding as it was presented in the paper results.

From table (17) the researcher concluded that at different cut-off points, nearly 30% of the Egyptian youth are multidimensionally poor. The deprivation of these youth reaches one-third of the weighted five indicators.

11- Robustness and sensitivity analysis of MPI indices (SYPE-MPI versus OPHI-MPI)

The main question this paper aims at answering whether the inclusion on other indicators to the global MPI indicators would represent significant addition and will better reflect the status of the poor. From the normative framework discussed earlier, it was made clear how the intrusion of these dimensions and indicators is essential in measuring who is poor. However, an important aspect of the construction of composite indicators is the robustness of the indicator and its statistical significance. Therefore, this section is dedicated to look into different statistical approaches to determine the significance of the proposed two SYPE-MPI indices versus OPHI-MPI.

This analysis is inspired by literature on poverty orderings in the unidimensional framework initiated by Atkinson (1987) and Foster and Shorrocks (1988).

1) Rank correlation coefficients

Useful method for sensitivity comparisons of MPI indices is to compute rank correlation coefficients to assess how sensitive the ranking of individuals by different MPI versions. The rank correlation will be measured using the following different coefficient:

- Pearson's correlation coefficient
- Spearman's rho correlation coefficient

Accordingly, the correlation between OPHI-MPI versus SYPE-MPI will be performed with different cut-off points to monitor how the change in the cut-off point will affect the correlation between OPHI-MPI and SYPE-MPI the 2 different types of the correlation coefficients. Ideally is the significant correlation coefficients across different cut-off points is high this means that insignificant inclusion to the newly proposed dimensions/indicators.

Table (18): Correlation between SYPE-MPI and OPHI-MPI at different cut-off points and equal weights using Pearson correlation coefficient

		m0_20p_ophi	m0_30p_ophi	m0_40p_ophi	m0_50p_ophi
m0_20p_sype	Pearson Correlation	.706**			
	Sig. (2-tailed)	0.000			
m0_30p_sype	Pearson Correlation		.543**		
	Sig. (2-tailed)		0.000		
m0_40p_sype	Pearson Correlation			.312**	
	Sig. (2-tailed)			0.000	
m0_50p_sype	Pearson Correlation				.178**
	Sig. (2-tailed)				.000

**. Correlation is significant at the 0.01 level (2-tailed).

Both SYPE-MPI and OPHI-MPI are scale variables. Therefore, they were categorized into five quintiles so that to measure their correlation using Spearman's rho correlation coefficients

referred to as SYPE-MPI , this index will combine the three main dimensions of the global MPI (Education, health, and standards of living) in addition to the newly proposed dimensions after its statistical validation (Unemployment, Decent work and Employment quality, Safety and the ability to go about without shame, Psychological and subjective wellbeing and empowerment). The other version of the index will be presented as, OPHI-MPI that will only include the three main dimensions of the global MPI. Concerning this study, for the two versions of the MPI, the deprivations in each indicator will be directly calculated on the individual level.

Since this paper will involve many iterations and trials to capture the answer of how to develop the global MPI, it was seen as a necessity to have a written automated program to facilitate the generation of the different versions of the MPI. For doing so, the researcher developed a Stata do-file that automatically generates SYPE-MPI and OPHI-MPI on the individual level with different parameters to serve the study questions. Both SYPE-MPI and OPHI-MPI will be computed following the global MPI of AF technique in explicitly weighting each dimension equally and each indicator within the dimension equally

In this paper, the researcher studies the SYPE-MPI and OPHI-MPI with different cut-off points ranging from 20% to 33% to investigate the changes in the percentage of the youth who are multidimensionally poor with respect to changes in the cut-off points "k".

9- Key findings of measuring SYPE-MPI

The below table displays the percentage of the Egyptian youth suffering from multidimensional poverty at different cut-off points. Roughly one in each five youth is deprived in 20 percent of the weighted seven dimensions while 8% of the youth population are deprived in one third of those weighted indicators.

Table (16): SYPE-MPI at different cut-off points

SYPE-Multidimensional Poverty Index (SYPE-MPI = H×A)	Incidence of Poverty (H)	Average Intensity across the poor (A)	Cut-off (k)
20.2%	0.68	0.30	20%
15.8%	0.48	0.33	25%
9.9%	0.26	0.38	30%
8.3%	0.21	0.39	33%

10- Main findings of measuring OPHI-MPI

In this section, the researcher is measuring the Multidimensional Poverty Index using the three main dimension of the OPHI-MPI. Namely; Education, health and standards of living with equal weights approach as follows:

Table (17): OPHI-MPI at different cut-off points

OPHI-Multidimensional Poverty Index (OPHI-MPI = H×A)	Incidence of Poverty (H)	Average Intensity across the poor (A)	Cut-off (k)
30.7%	0.703	0.437	20%
30.7%	0.701	0.438	25%
30.6%	0.700	0.438	30%
30.6%	0.700	0.438	33%

This factor/dimension will be dropped due to very low internal reliability. However, health insurance indicator will be kept to represents the health dimension.

Framework of SYPE-MPI after validation

From the previous validation, the SYPE-MPI will be categorized as follows:

Table (15): SYPE-MPI after validation

Dimension	Indicator
1.Education	
	General education
	Years of schooling
	Child Education
	Basic education school attendance
	Child Labor
2.Health	
	Health insurance
3.Standards of living	
	Wealth index
4.Unemployment	
	Unemployed active individuals
	Discouraged unemployment
5.Decent work and Employment quality	
	Job stability
	Informal Employment
	Occupational hazard (accidents, illness, and workplace exposures)
	Satisfaction at work
6.Safety and the ability to go about without shame	
	Safety
	Exposure to injuries or Perceptions of safety and violence or Encountering violence/accidents or Respectful treatment
	The ability to go about without shame
	Experiencing Harassment
	Shame proneness
7.Psychological and subjective wellbeing and empowerment	
	Empowerment
	Freedom of making decision
	Wellbeing
	Happiness
	Meaning of life

8- Brief on Calculating the developed global MPI

Given that the main objective of this paper is to develop the global MPI which was launched by OPHI, the researcher will mainly calculate two versions of the global MPI index using the Survey of Young People in Egypt data. The first index will be

analysis based on household asset ownership and housing characteristics. The variables used to construct the asset score include a number of housing quality variables: the number of persons per room, the materials of the floors, drinking water source, type of toilet facility, presence of a kitchen, type of cooking fuel, electricity, garbage disposal method, and ownership of 26 assets and durable goods. The wealth index variable covered all the standard of living indicators in addition to other housing characteristics related variables. Wealth quintile variable is categorized as lowest, Second, Middle, Fourth, and Highest. The key point the researcher faced was to determine at the wealth index quintiles the individual should be considered deprived. After some literature review[19] , individual living in the poorest quintile and the second poorest quintile will be considered deprived.

Factor7: Child Education

This dimension includes the following indicators (Basic education school attendance, and Child Labor)

Table (12): Reliability Statistics for child education

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.409	.409	2

It is worth noting that Child labor was also present in factor (1).However, the normative justification argues that child labor and school attendance for individuals in the basic education age group are more relevant. Therefore, this indicator will be excluded from factor(1) noting that the value of cronbach's alpha will be (0.797) slightly higher compared to the initial cronbach's alpha value with the inclusion of child labor

Factor8: Physical safety and security

This dimension includes the following indicators (Perceptions of safety and violence, Encountering violence/accidents, and Respectful treatment)

Table (13): Reliability Statistics for Physical safety and security

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.147	.226	3

This factor/dimension revealed very low internal reliability. Therefore, in order not to lose this information, these indicators will be aggregated with exposure to injury indicator representing the safety indicator

Factor 10: Health

This dimension includes the following indicators (Disability , chronic diseases)

Table (14): Reliability Statistics for health

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.109	.132	2

[19] Review the paper of who are the poor? New regional estimates of the composition of education and health 'poverty' by spatial and social inequalities, Andy Sumner, April 2013

Table (7): Reliability Statistics for Psychological and subjective wellbeing and empowerment

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.646	.649	3

Factor3: Safety and the ability to go about without shame

This dimension will include the following indicators (Experiencing Harassment, Shame proneness, and Exposure to injuries)

Table (8): Reliability Statistics for Safety and the ability to go about without shame

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.538	.578	3

Factor4: Education

This factor includes the schooling indicator

Factor5: Unemployment

This dimension will include the following indicators (Unemployed active individuals, and discouraged unemployment)

Table (9): Reliability Statistics for unemployment

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.556	.648	2

Factor 6: Standards of living

This dimension will include the following indicators (Electricity, Water, Sanitation, and Assets)

Table (10): Reliability Statistics for Standards of living

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.208	.296	4

It is noted that factor 8 includes: Floor, Cooking Fuel, water, and sanitation indicators with cronbach's alpha=.146. Therefore, the 6 indicators of living standards will be aggregated in the same factor.
This inclusion of the 6 indicators resulted in raising cronbach's alpha value as follows:

Table (11): Reliability Statistics for Standards of living using the 6 indicators

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.269	.356	6

Due to the low internal consistency between these six indicators, another approach was seen to be followed. According to the Survey of Young People in Egypt report, a proxy for household wealth has been constructed using factor

Rotated Component Matrix[a]										
	Component									
	1	2	3	4	5	6	7	8	9	10
Informal Employment	.877									
Occupational hazard (accidents, illness, and workplace exposures)	.796									
Satisfaction at work	.711									
Control over personal decisions				.656						
Domain-specific Autonomy										
Freedom of making decision		.745								
Perceptions of safety and violence								.666		
Exposure to risks of injury			.335							
Encountering violence/accidents								.603		
Experiencing Harassment			.880							
Confidence in the future										
Shame proneness			.864							
Respectful treatment								.552		
Happiness		.733								
Meaning of life		.780								

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 9 iterations.
Values of less than 0.3 are excluded (only items of loading higher than 0.300)

In order to support the results of the factor analysis and the normative judgment of the selection of dimensions and indicators, Cronbach's α Alpha[18] coefficient will be calculated for each subset of indicators to check internal consistency

Factor 1: Decent work and Employment quality

This dimension will include the following indicators (Child labor, Job stability, Informal Employment and Occupational hazard (accidents, illness, and workplace exposures))

Table (6): Reliability Statistics for Decent work and Employment quality

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.775	.771	5

Factor2: Psychological and subjective wellbeing and empowerment

This dimension will include the following indicators (Freedom of making decision, Happiness, and Meaning of life)

[18] For more information on Cronbach's α Alpha coefficient, see Cronbach LJ (1951). "Coefficient alpha and the internal structure of tests".

7-SYPE-MPI Index Validation

In the previous table, a theoretical framework of SYPE-MPI has been set. So far, the new dimensions are identified as well as the sub-indicators. Now, it is essential to take a pause to evaluate the validity of the SYPE-MPI by the following:

1)Factor: Exploratory factor analysis indicates that items converge and discriminate data according to evaluated constructs

2)Reliability: High internal consistency (Cronbach's α) among items in each dimension.

Results of Exploratory factor analysis

The 30 indicators of deprivations (i.e each indicator is a dummy variable where 0 indicating that the person is not deprived while 1 indicates that the person is deprived in indicator X) are tested with the explanatory factor analysis using principal component extraction method, and Varimax rotation method[17]

Table (4): KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.690
Bartlett's Test of Sphericity	Approx. Chi-Square	60586.116
	Df	435
	Sig.	.000

The above table indicates the valid use of the explanatory factor analysis with the investigated 30 indicators since the KMO measure of sampling adequacy =0.690 validating the adequate use of factor analysis with the sampling size. In addition, Barlett test is highly significant at 95% confidence level.

Number of selected factors is based on the initial eigenvalues that are greater than "1". These are the only factors retained in the rotated component matrix

Table (5): Table of rotated component matrix

Rotated Component Matrix[a]										
	Component									
	1	2	3	4	5	6	7	8	9	10
Years of schooling				.702						
Basic education school attendance							.811			
Disability										.677
Chronic Diseases										.735
Medical Insurance	-.373-			-.562-	-.300-					
Electricity						.708				
Floor									.602	
Cooking Fuel									.608	
Water						.529			.493	
Sanitation						.549			.340	
Assets				.368		.354				
Unemployed active individuals					.851					
Discouraged unemployment					.814					
Child labor	.357						.647			
Job stability	.680									

[17] using the Promax with Kaiser Normalization.Component Scores rotation method gives the same results as the varimax method .

MPI Dimension	SYPE-MPI Indicator	Deprived if
5. Decent work and Employment quality	Occupational hazard (accidents, illness, and workplace exposures)	If an individual is encountering any kind of occupational hazards
	Satisfaction at work	If an individual is NOT satisfied at work
6. Agency and Empowerment	Control over personal decisions	If a female individual did NOT have control over her marriage decision
	Domain-specific Autonomy	If the female individual did NOT decide to wear the veil herself
	Freedom of making decision	If an individual can NOT make decisions
7. Physical safety and security	Perceptions of safety and violence	If an individual is carrying any kind of weapons around- this is a proxy variable indicating that this person feeling unsafe excluding individuals whose jobs require carrying a weapon i.e. armed forces, policemen, guards..etc
	Exposure to risks of injury	If an individual is exposed to risk of injury in public transportation or the street
	Encountering violence/accidents	If an individual has ever encountered physical violence or accident
	Experiencing Harassment	If a female individual has ever experienced any sexual harassment
	Confidence in the future	If an individual is Not confident about his/her future
8. The ability to go about without shame and Isolation	Shame proneness	If a female has ever experienced any sexual harassment and did not tell anyone about it- this is a proxy variable reflecting the feeling of shame
	Respectful treatment	If an individual has ever encountered police violence
9. Psychological and subjective wellbeing	Happiness	If an individual is NOT feeling happy with his/her life
	Meaning of life	If an individual is feeling worthless or Not playing useful role in life

The proposed dimensions and indicators

Table (3): Inside the proposed developed global MPI (SYPE-MPI)

MPI Dimension	SYPE-MPI Indicator	Deprived if
1. Education	Years of schooling	If an individual has NOT completed five years of schooling
	Basic education school attendance	If an individual is in Basic education age and is NOT attending school
2. Health	Disability	If an individual is disabled
	Chronic Diseases	If an individual is suffering from a chronic disease
	Medical Insurance	If an individual is NOT covered by any type of health insurance
3. Standard of Living	Electricity	If an individual is living in a household that has no electricity
	Sanitation	If an individual is living in a household where sanitation facility is not improved(according to the MDG guidelines), or it is improved but shared with other households
	Water	If an individual is living in a household that does not have access to clean drinking water (according to the MDG guidelines) or clean water is more than 30 minutes walking from home
	Floor	If an individual is living in a household of dirt, sand or dung floor
	Cooking Fuel	If an individual is living in a household cooks with dung, wood or charcoal
	Assets	If an individual does not own *personally or jointly* more than one of: radio, TV, telephone, bike, motorbike or refrigerator, and does not own a car or truck
4.Unemployment	Unemployed active individuals	If an individual is economically active but unemployed
	Discouraged unemployment	If an individual is unemployed active person who is available for work and no longer actively searching for a job
5.Decent work and Employment quality	Child labor	If the individual is aged less than 18 years old and working
	Job stability	If an individual is irregular worker (casual or seasonal)
	Informal Employment	If an individual does NOT have contract or social insurance

5.6 Psychological and Subjective Wellbeing

"Psychological and subjective wellbeing stand to contribute a richer perspective to our understanding of human experience and values, and particularly the importance of its non-material components. Samman (2007) advocates a two-pronged approach to psychological wellbeing based on 1) perceptions of *meaning in life*, defined by the respondent based on his/her own unique potential; and 2) the ability to strive towards excellence in fulfilling this idea. To capture *subjective wellbeing*, she proposes the separate measurement of life satisfaction and happiness, and that the satisfaction measure consider life overall and several distinct domains that are argued to be important – namely, material wellbeing (food, income, housing); health, work, physical safety, relations with friends and with family, education, one's neighborhood, the ability to actively help others, and wellbeing from spiritual/religious/philosophical beliefs" [16]

5.7 Selecting Indicators

The strengths and weaknesses of composite indicators largely derive from the quality of the underlying variables. Ideally, variables should be selected on the basis of their relevance, analytical soundness, timeliness, accessibility, *etc.* The choice of indicators is guided by the theoretical framework of the proposed dimensions elaborated earlier.

6- Data Source

The data used for the proposed development to global Multidimensional Poverty Index is the "Survey of Young People in Egypt (SYPE)" data that was conducted by Population Council in collaboration with the Egyptian Cabinet, Information and Decision Support Center. The Survey was carried out in 2009. The SYPE collected data on the five key life transitions of education; work; family formation; health; and civic and political participation.

deliver for people, and economic growth that expands opportunities for productive jobs and enterprise development.
The ILO Framework Work Indicators covers four strategic pillars of the Decent Work Agenda (full and productive employment, rights at work, social protection and the promotion of social dialogue).

5.2.2 Employment quality

Existing employment data generally focuses on formal employment and overlooks the kinds of employment open to poor people, as well as indications of the potential meaning of employment. Lugo (2007) proposes four indicators of employment to help answer these questions, at a global level. Four of these relate to the quality of employment. These comprise informal employment; income from self-employment; occupational safety and health; and under- and over-employment[12].

5.3 Agency and Empowerment

Sen identified Agency as 'what a person is free to do and achieve in pursuit of whatever goals or values he or she regards as important' . While Kabeer (2001) defines, empowerment in terms of the ability to make choices that could have an important impact on one's life, which would therefore be closely related to the overall experience of poverty. The empowerment dimension was not included in the UNDP-MPI due to lack of internationally comparable set of indicators[13].

5.4 Physical Safety and security

Violence undoes the development gains achieved in areas such as education, health, employment, income generation and infrastructure provision. There is a need for reliable and comparable data of violence against both person and property to greater inform our understanding of these concepts. Diprose (2007) proposes a series of questions to measure violence derived from both conflict and crime – two categories that are not normally combined in survey instruments. In particular, the article seeks to identify the incidence and frequently of both general crime and conflict-related violence against person and property; as well as perceptions of threat(s) to security and safety, both now and in the future[14].

5.5 The Ability to go about without Shame

Shame and humiliation are essential to our understanding of poverty yet internationally comparable data on these dimensions are missing[15]. According to the study of (Shame, Humiliation and Social Isolation: Missing Dimensions of Poverty and Suffering Analysis) Data on discrimination is obtained on the basis of responses to three questions:

1) Have you been treated in a way that you felt was prejudiced during the past three months?
2) Who treated you in a way that you felt it was prejudiced?
3) Why were you treated in a way that you felt it was prejudiced?

[12] Alkire, 2007
[13] Lahoti, Swaminathan and Vijaya , 2014
[14] Alkire, 2007
[15] Sen 1997, 2000b

3) **In the Study of Mills, Zavaleta and Samuel "Shame, Humiliation and Social Isolation: Missing Dimensions of Poverty and Suffering Analysis, 2014"**, the authors concluded that the use of particular indicators of shame, humiliation, and social isolation can better indicate differential distributions of suffering and help identify individuals and sub-groups within people living in poverty that are affected by concrete and particularly hurtful situations. Consequently, they can help to identify levels of suffering which are higher within a specific population.

5- Unfolding the new dimensions

Based on the previously discussed literature on missing dimensions on poverty data, the enhancement of the global MPI will rely on keeping the three main dimensions of the global MPI (Education, Health, and standard of living) in addition to the newly proposed dimensions derived from the previous illustrated efforts namely, Unemployment, decent work and employment quality, Agency and Empowerment, physical safety and security, the ability to go without shame and isolation , and Psychological and subjective wellbeing. These dimensions mainly represent the missing dimensions in poverty data, they have been considered human rights; identified in Voices of the Poor. They are summarized in table (2) and discussed in turn as follows:

Table (2): General Dimensions suggested to be integrated to MPI

Dimensions
1. Unemployment
2. Decent work and Employment quality
3. Agency and Empowerment
4. Physical safety and security
5. The ability to go about without shame and Isolation
6. Psychological and subjective wellbeing

5.1 Unemployment

One can see that even a long time ago with Arthur Okun, macroeconomic unemployment was taken *cardinally* as part of the multidimensional 'misery' index. Relaying this dimension into a context of microeconomic household surveys and ordinal data and to broaden the deprivation analysis in line with the MDGs, researchers can look at the ordinal situation where the economically active but unemployed individuals of the household are youth (aged 18–24), young adults (aged 25–34), women, and other types of employment status such as 'own account' and 'contributing family workers' that can be coded by ordinal or categorical data[11].

5.2 Decent work and Employment quality

5.2.1 Decent work

The Decent Work concept was formulated by the International Labour Organization (ILO) constituents. It is based on the understanding that work is a source of personal dignity, Household stability, peace in the community, democracies that

[11]Currently available data can be used to calculate deprivation in the unemployment dimension not necessarily for all countries but at least for those countries for which unemployment data are available, to begin including such a dimension (Nawar, 2013)

indicators. Such flexibility offered in the adopted weighting technique raised a crucial question; can the MPI be improved in the context of adding more dimensions? Moreover, if so what dimensions and indicators should be added?

The literature has agreed that there are several missing dimensions in poverty data in general and multidimensional poverty in particular. In this paper, the researcher tries to Investigate and integrate these missing dimensions to the measurement of Multidimensional Poverty Index. In addition, what could be the contribution of the newly added dimensions in developing the MPI?

The key objective of this paper is to develop the Multidimensional Poverty Index (MPI) using the Survey of Young People in Egypt (SYPE) 2009 to better measure the index.

4.1 Efforts done to identify Missing Dimensions in Poverty data

1) Voices of the poor[8]

Deepa Narayan, Principal Social Development Specialist in the World Bank's Poverty Group, initiated and led the research of Voices of the poor. From the book excerpts, the dimensions of poverty according to the poor could be summarized as follows:

1. Material Wellbeing: Having Enough (Food, Assets, Work)
2. Bodily Wellbeing: Being and Appearing Well (Health,, Appearances, Physical Environment)
3. Social Wellbeing(Being able to care for, bring up, marry and settle children, Self-respect and dignity, Peace, harmony, good relations in the family/community)
4. Security (Civil peace ,A physically safe and secure, environment ; Personal physical security, Lawfulness and access to justice; Security in Old Age , Confidence in the Future)
5. Psychological Wellbeing(Peace of Mind, Happiness, Harmony (including a spiritual life and religious observance)
6. Freedom of Choice and Action

2) The Oxford workshop, 'Missing Dimensions of Poverty Data'[9]

From the sparking debates through this workshop, they identified five areas of great importance in studying poverty data for which insufficient data exist[10]:

- Employment, particularly informal employment, with special attention as to the quality of Employment
- Empowerment, or agency: the ability to advance goals one values and has reason to value
- Physical safety, focusing on security from violence to property and person, as well as perceived Violence
- The ability to go about without shame, to emphasize the importance of dignity, respect and Freedom from humiliation
- Psychological and subjective wellbeing, to emphasize meaning, its determinants, and Satisfaction

[8] Narayan, 2000

[9] this workshop took place on 29-30 May 2007 at the University of Oxford, and at the Centre for Human and Economic Development Studies (CHEDS)

[10] Alkire, 2007

Dimension	Indicator	Deprived if...	Related to...	Relative Weight
Standard of Living	Floor	The household has dirt, sand or dung floor	MDG7	(1/3*1/6) 0.055556
	Cooking Fuel	The household cooks with dung, wood or charcoal	MDG7	(1/3*1/6) 0.055556
	Assets	The household does not own more than one of: radio, TV, telephone, bike, motorbike or refrigerator, and does not own a car or truck	MDG7	(1/3*1/6) 0.055556

Note: MDG1 is *Eradicate Extreme Poverty and Hunger*, MDG2 is *Achieve Universal Primary Education*, MDG4 is *Reduce Child Mortality*, MDG7 is *Ensure Environmental Sustainability.*
* Adults are considered malnourished if their Body Mass Index is below 18.5. Children are considered malnourished if their z-score of weight-for-age is below minus two standard deviations from the median of the reference population.

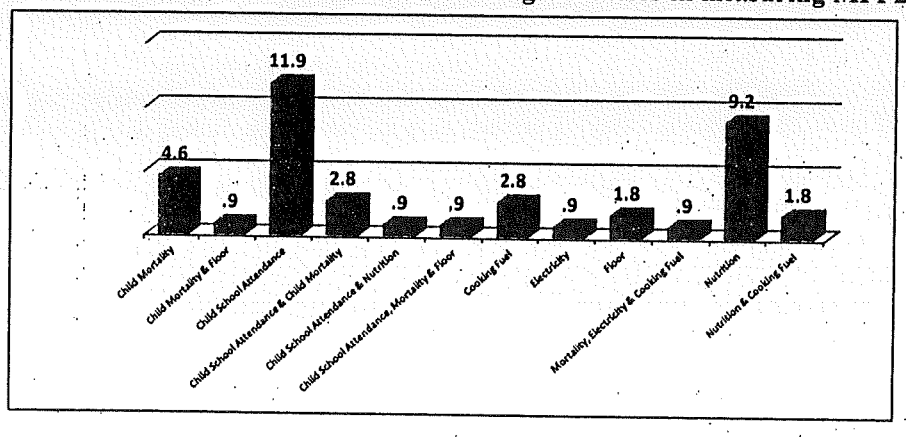
3- Differentials in number of indicators and dimensions used in measuring global MPI

As illustrated previously, the MPI has three dimensions and uses 10 indicators, which reflect some of the MDGs and thus international standards of poverty. Each dimension is equally weighted, and each indicator within each dimension is equally weighted. The MPI methodology follows Alkire and Foster (2011).

The pumping question here is that, since the surveys used differ across the countries as shown in figure (1) the availability of the indicators also differ accordingly, in such case, how can the MPI still be globally comparable?

Reviewing the number of indicators used to calculate MPI 2011 across the 109 countries, it is indicated that for 2011 round, 31% of the countries (34 country) missing one indicator, 6.4% (7 countries) missing 2 indicators and 1.8% (2 countries) missing 3 indicators. Similar results are found in 2013 round where 30% of countries missing 1 indicator, 5.8% 6 indicators and 1% missing 3 indicators.

Figure (1): Distribution of missing indicators in measuring MPI 2011



The MPI explicitly weights each dimension and each indicator within the dimension equally. Therefore, in case where one or more indicators are missing, the weights are still divided equally between the dimensions and within each dimension indicators.

4- Can global MPI be developed in terms of adding more dimensions?

The absence of one or more of the 10 MPI indicators can easily be overcome by re-weighting the indicators, which means that there is always a room for adding new

Poverty Index (MPI). The first round of estimates was released in July 2010[5], and in November in the Human Development Report (UNDP, 2010)[6] raising intense interest and debate[7].

Global MPI is an index of acute multidimensional poverty. It assesses the nature and intensity of poverty at the individual level, creating a vivid picture of people living in poverty within and across countries, regions and the world. The MPI has three dimensions: health, education, and living standards, which are measured using 10 indicators. It is the first international measure of its kind; it offers an essential complement to income poverty because it measures deprivations directly. Thus, the MPI can be used to show aspects in which people are deprived and help to reveal the interconnections among deprivations.

Aiming at better measuring the Multidimensional Poverty, the presented paper relies on developing the global MPI by the inclusion of some important poverty dimensions yet missing in it.

2- MPI Indicators' weights and cut-off point

Global MPI reveals the combination of deprivations that batter a household at the same time. A household is identified as multidimensional poor if, and only if, it is deprived in some combination of indicators whose weighted sum is 30 percent or more of its three dimensions (Health, Education, Standards of living). The cut-offs for each indicators are based on the Millennium Development Goals. Where no standard was possible, the OPHI working team consulted the literature and also implemented multiple cut-offs to explore the sensitivity of the overall ranking to them. The indicators and cut-off points are summarized in the table below

Table (1): Dimensions, indicators, cut-off and weights of the MPI

Dimension	Indicator	Deprived if…	Related to	Relative Weight
Education	Years of Schooling	No household member has completed five years of schooling	MDG2	(1/3*1/2) 0.166667
	Child School Attendance	Any school-aged child is not attending school in years 1 to 8	MDG2	(1/3*1/2) 0.166667
Health	Mortality	Any child has died in the family	MDG4	(1/3*1/2) 0.166667
	Nutrition	Any adult or child for whom there is nutritional information is malnourished*	MDG1	(1/3*1/2) 0.166667
Standard of Living	Electricity	The household has no electricity	MDG7	(1/3*1/6) 0.055556
	Sanitation	The household's sanitation facility is not improved (according to the MDG guidelines), or it is improved but shared with other households	MDG7	(1/3*1/6) 0.055556
	Water	The household does not have access to clean drinking water (according to the MDG guidelines) or clean water is more than 30 minutes walking from home.	MDG7	(1/3*1/6) 0.055556

[5] Alkire & Santos, 2010

[6] The MPI replace the Human Poverty Index (HPI), which had been reported since 1997 (Anand & Sen, 1997). Dealing with the data constraints of the time, the HPI used aggregate data. The MPI uses individual level data to identify the people who experience overlapping deprivations.

[7] See for example the academic forum published in the Journal of Economic Inequality, volume 9 numbers 2 and 3.10.

A REVIEW ON THE GLOBAL MULTIDIMENSIONAL POVERTY INDEX (MPI): A MORE DEVELOPED APPROACH ON THE USED DIMENSIONS AND INDICATORS

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Abstract

The aim of this paper is to examine the significance of adding more dimensions to the global Multidimensional Poverty Index (MPI). In the pursue of the paper objective, the researcher calculated two versions of the global MPI using the Survey of Young People in Egypt data. The first version uses the three main dimensions of the global MPI namely, health, education and standard of living while the second version combines the three main dimensions in addition to the four newly proposed ones. In this paper, the researcher found empirical and descriptive evidence on the importance of adding the newly proposed dimensions to the global MPI.

Keywords: Poverty, Multidimensional Poverty Index, MPI, SYPE, Robustness, Sensitivity.

1- Introduction

"In a country well governed, poverty is something to be ashamed of. In a country badly governed, wealth is something to be ashamed of."

Confucius in the Analects (Chapter VIII)

The important question of how poverty should best be measured has been discussed widely in economics and the topic has generated a large literature. Interest in the subject extends far beyond academia. Better measurement of poverty can provide better guidance to policy makers as to where resources are most needed.

Amartya Sen, Nobel laureate in Economics, argued since 1980 that poverty should be conceived not as lowness of income but rather in terms of capability deprivation. "What the capability perspective does in poverty analysis is to enhance understanding of the nature and causes of poverty and deprivation by shifting primary attention away from *means* to *ends* that people have reason to pursue, and, correspondingly to the *freedoms* to be able to satisfy these ends"[4].

Informed and inspired by previous work of Amartya Sen and by the possibility of implementing a direct approach, between 2009 and 2010, the Oxford Poverty and Human Development Initiative in collaboration with the United Nations Development Program's Human Development Report Office, developed the Multidimensional

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Some lessons learned

The positive impacts of Oportunidades show that conditional cash transfer programs of this nature can be an effective feasible instrument in both reducing current poverty as well as improving the future of children through increased investment in their health and education.

The experience of Oportunidades also shows that it is feasible to carry out a targeted conditional cash transfer program on a very large scale even within poor isolated areas with few services, and in particular in a developing country with a limited welfare state.

Among the important factors behind the success of the program is that the initial evaluation was planned from the beginning of the program. This ensured the feasibility of having a control group and also insured that results were available at an early juncture in the program, when program changes are easier to carry out and when programs may be more susceptible to budget cuts. Involving prestigious academics in the evaluation also was important; this made the credibility of the results difficult to question.

7. Recommendations

1- Increasing awareness of the phenomenon of IGT of poverty in Egypt, with an emphasis on the dangers of an outbreak this phenomenon on the future of the next generation of children in Egypt.

2- Conducting more rounds of longitudinal household surveys which containing data that measure poverty, which enables researchers to trace IGT of poverty in Egypt.

3- Speeding up the establishment of a research center specializes in the field of studying chronic poverty in Egypt , which must be win a special government support translates into a large proportion of government budget oriented to fight poverty. The first task of the research center is measure the size of the phenomenon of IGT of poverty and developed non-traditional ways to treat it.

4- Studying the successful experiences of developing countries that have been able to break the cycle of poverty and to draw learned lessons from them.

survive changes in government. An external firm, the International Food Policy Research Institute (IFPRI) was hired to conduct the evaluation, along with some academic economists.

The results of the IFPRI evaluation can only be characterized as extremely positive. In the words of the Coordinator of the Oportunidades-IFPRI evaluation, Emmanuel Skoufias: The results of the evaluation of IFPRI show that after only three years, poor Mexican children living in the rural areas where Oportunidades operates have increased their school enrollment, have more balanced diets, are receiving more medical attention, and are learning that the future can be very different from the past.

Important positive impacts were reported in school enrollment, health clinic attendance, and nutrition. In the case of education, the largest impacts were reported on children who enter secondary school, where impacts represent a percentage increase of enrollment over 20 percent for girls and 10 percent for boys. Significant health and nutrition effects were also reported. Oportunidades children 1-5 years have a 12 percent lower incidence of illness than non-Oportunidades children. Additionally, data suggest that Oportunidades has had large impact on increasing child growth and in reducing child stunting.

While the first phase of the Oportunidades evaluation concluded in the year 2000 (with the end of the three-year contract with IFPRI), there have been a number of important continuing efforts in the evaluation. Given the expansion of the program to urban areas, a new urban evaluation is under way. Additionally, the rural evaluation is continuing with the objective of analyzing the medium term impacts of the program, such as the effect of increased schooling on the future income of its participants.

Changes in the program

There have been two principal modifications in Oportunidades, in large part, due to the IFPRI evaluation. First, the program has been extended to urban areas. Oportunidades was originally a rural program focused on primary and secondary education, although its plan was to first achieve a generalized coverage in rural areas and then slowly extend to poor urban areas. This is exactly the pattern that has evolved.

The second important change has been the extension of education grants to the high school level. And, the Fox administration recently announced a new component of Oportunidades called "Youth with Opportunities" (Jovenes con Oportunidades), a savings plan for participating high school students that grows with each year, from ninth grade through graduation.

Implementation

The critical design and implementation of Oportunidades includes many features. The three chief components of Oportunidades are education, health, and nutrition. Under the education component, grants are provided for primary through high school. The grants increase as children progress to higher grades and, beginning at the secondary level, are slightly higher for girls than for boys. The amounts of the monthly grants range from about $10.50 in the third grade of primary to about $58 for boys and $66 for girls in the third year of high school. Beginning with secondary school, the grants are higher for girls to remain in school because they tend to have a higher drop-out rate; the health component provides basic health care for all members of the family, with a particular emphasis on preventive health care. This service is provided by government public health institutions. The nutrition component includes a fixed monetary transfer, equal to about $15.50 monthly, for improved food consumption, as well as nutritional supplements for children between the ages of four months and two years, malnourished children aged 2 to 4, and pregnant and lactating women.

The program is targeted, using both geographical targeting and proxy means tests, where household surveys for all households in eligible communities are carried out. Families are chosen through the analysis of the socio-economic information at the central government level. Payments are given to the female head of family (in accordance with international literature showing women make *better* use of financial resources); The program was conceived and staffed by a group of experienced and highly credential government officials in different ministries of the government and with strong presidential support. This has carried over to an effective collaboration between the education, health, finance, and social security ministries of the Mexican Government on the operation of the program. It has a rigorous, ongoing evaluation process, with the first stage administered by an external and independent organization, the International Food Policy Research Institute (IFPRI).

The credibility of this evaluation has helped strengthen the program's legitimacy in Mexico, leading to its expansion into urban areas as well as support across political administrations, and to international recognition, including a loan of one billion dollars from the Inter-American Development Bank. Oportunidades impact analysis: credibility and effectiveness Oportunidades was the first social program in Mexico to carry out a rigorous independent evaluation of program impacts that included randomly assigned treatment and control groups. Given the size and ambitions of the program, program officials emphasized the importance of accurate, credible data as a strategy to measure effectiveness and to try to ensure that the Program would

guaranteed maternity/paternity leave to help them nurture the infant. The government then provides high-quality day care, enabling the mother – knowing that the child is in a safe environment – to return to work. The government ensures that all children have a place in preschool, so that they are ready for formal schooling by the age of six. And health care is universal, so the child can grow up healthy.

Finally, we would like to stress that to break the cycle of poverty; a country needs to invest in its people.

6. Mexico's *Oportunidades* Program: Case Study Summary

Oportunidades is the principal anti- intergenerational poverty program of the Mexican government. (The original name of the program was Progresa; the name was changed in 2002.) Oportunidades focuses on helping poor families in rural and urban communities invest in *human capital*—improving the education, health, and nutrition of their children—leading to the long-term improvement of their

economic future and the consequent reduction of poverty in Mexico. By providing cash transfers to households (linked to regular school attendance and health clinic visits), the program also fulfils the aim of alleviating current poverty. The program design was based on the idea that poor families do not invest "enough" in human capital and are thus caught in a vicious circle of intergenerational transmission of poverty.

According to Oportunidades's vision, poor families are aware of the benefits of investing in their children but cannot afford the monetary costs of attending school or the opportunity costs of sending children to school (the income or value of income that children would earn if they were working, rather than attending school). Since families need this income for current consumption, they take their children out of school at early ages and send them to work. Thus, the idea of Oportunidades is to provide parents the equivalent of that income to send their children to school instead. Oportunidades provides monetary educational grants to participating families for each child under 22 years of age who is enrolled in school between the third grade of primary and the third grade of high school. The program began operating in 1997 in poor rural areas and recently expanded to cover urban areas. The number of families benefiting from Oportunidades has surpassed 4 million, with over 2.5 million families in rural areas and over 1.5 million in urban areas. Oportunidades also has won a significant commitment from the government, currently representing 46.5 percent of Mexico's federal annual anti-poverty budget.

actually facilitate survival in the midst of bad or deteriorating socio-economic, political or environmental conditions; keeping the poor from destitution or death, but often helping to reproduce the social and economic structures that obstruct escape from poverty – a form of 'adverse incorporation'.

5. How to Break the Intergenerational Cycle of Poverty?

Poor people live in poor neighbourhoods with poor schools. Parents are often unemployed, ill, divorced, or even incarcerated. Children become trapped in a persistent generational cycle of poverty, despite the society's general affluence. Too often, children growing up in poverty end up as poor adults.

It must be clear that break the cycle of poverty cannot be achieved by any single remedy but that it requires a combination of policies designed for country specific (or even local) conditions. Governments have a unique role to play to ensure that all young members of a generation – poor children as well as rich ones – have a chance. A poor kid is unlikely to break free of his or her parents' poverty without strong and effective government programs that support high-quality education, health care, and decent nutrition. This is the genius of "social democracy", the philosophy pioneered in Scandinavia, but also deployed in many developing countries, such as Costa Rica. The idea is simple and powerful.

All people deserve a chance, and society needs to help everybody to secure that chance. Most important, families need help to raise healthy, well-nourished, and educated children. Social investments are large, financed by high taxes, which rich people actually pay, rather than evade.

A country's economic success depends on the education, skills, and health of its population. When its young people are healthy and well educated, they can find gainful employment, achieve dignity, and succeed in adjusting to the fluctuations of the global labour market. Businesses invest more, knowing that their workers will be productive.

Why is the challenge of education unmet in so many countries? Some are simply too poor to provide decent schools. Parents themselves may lack adequate education, leaving them unable to help their own children beyond the first year or two of school, so that illiteracy and innumeracy are transmitted from one generation to the next. The situation is most difficult in large families (say, six or seven children), because parents invest little in the health, nutrition, and education of each child.

This is the basic method to break the intergenerational transmission of poverty. A poor child must has benefits from the start. The child's parents have

Household panel surveys can meet these data requirements relatively well. Family life surveys and other longitudinal studies, such as retrospective surveys, cohort panels, rotating panels and linked data from administrative records, might also be used, but have strengths as well as weaknesses (Jenkins, 2007b). A range of statistical methods can be applied to work related to the IGT of poverty, including parametric regression models with "level", "sibling difference" and "instrumental variable" estimators, non-parametric bounds estimators and propensity score matching methods (Jenkins, 2007a).

4. Culture of Poverty and Intergenerational Transmission of Poverty

The idea of a culture of poverty was developed by Oscar Lewis (1965; 1969) and suggests that poverty is perpetuated through low levels of education, a lack of participation in mainstream society and the inherent socio-psychological, political and economic traits of the poor themselves. This theory suggests that the poor have a different culture to the rest of society which is characterized by deviant attitudes, values and behaviours (Patterson, 2000). These affect the way in which capital is transmitted intergenerationally and may result in individuals being unable or unwilling to take advantage of emergent opportunities (Moore, 2001).

Moore (2001) summarizes the ongoing debate on the "culture of poverty" theory and shows that at one end of a continuum, there are those (e.g. Edward Banfield) that believe that much, if not most, poverty is based upon the "innate" characteristics of the poor, sometimes called the "underclass". Moore links this approach to concepts of the "deserving" and "undeserving" poor, and suggests that it is inherently racist and classist. This view suggests that any attempt to eradicate or alleviate poverty among the "underclass" is doomed to failure. The opposing view suggests that poverty emerges and persists solely because of socio-economic structures external to the value systems and behaviours of the poor. In between lie those, like Lewis, who believe that 'cultures of poverty' have emerged over generations to enable poor people to cope with their situation. Their values, beliefs and behaviours were once an appropriate response to the social, economic and political barriers that they faced, but have become ossified, and now limit the current generation's ability to respond to opportunities.

Moore (2001) suggests that the growing literature on coping strategies provides an alternative way of looking at 'culture of poverty' as it links the behaviour of the poor to the context in which they live. It is likely that the coping and survival strategies passed on from one generation to the next

designed to enhance the quality of recall and to reduce error and bias when respondents are reconstructing information about the past.

Quantitative analysis of survey-based data can also be useful in exploring the IGT of poverty. There is strong evidence from quantitative analysis of household surveys from industrialized countries that growing up poor has a negative impact on future life chances. But Jenkins (2007b) argues that the degree of impact depends on the variables explored and the analytical approach used. Therefore, the choice of method and analytical approach adopted matters.

Robust quantitative data collection and analysis on intergenerational poverty is challenging in the most well-resourced contexts; in developing countries, the challenge is even greater. Where obstacles are overcome, quantitative analysis can improve the basis for understanding poverty trajectories and exploring the impact that changes (including policy changes) can have the effect on poverty outcomes (Behrman, 2006). However, quantitative data need to meet stringent criteria if they are to be useful for the empirical analysis of the IGT of poverty.

Stephen Jenkins and Thomas Siedler (2007b) set out several criteria that quantitative data need to meet to be suitable for the empirical analysis of the intergenerational transmission of poverty:

- Ability to link data within families across generations, so that individual outcomes can be linked with family background;
- Availability of appropriate measures of well-being and poverty, as well as measures of other factors relevant to intergenerational poverty processes (e.g. parental education); and
- Availability of a large, representative sample that remains so over time and contain repeated observations on key variables (e.g. income) over time, to facilitate "longitudinal averaging".

If these conditions are met, the likelihood of measurement errors and transitory variation are reduced, and researchers can investigate issues such as whether the timing of poverty spells during childhood matter (Jenkins, 2007b).

Where they exist, it is useful to have data on variables that provide insights into individual and familial decisions related to intergenerational poverty. These variables may include capacities and endowments of the "child" (human, physical, financial and "genetic" assets) and the factors that determine and affect these. It is also useful to have information on parental background, asset transfers and resource allocations at different points in the life-course, "sharing rules" for the household, community context and market and public services provision (e.g. health and education).

Stephen Jenkins and Thomas Siedler (2007) explored similar issues but in relation to panel data. All these studies resulted in short, accessible papers to guide researchers wishing to study the IGT of poverty in developing countries. The methods have been applied in subsequent studies (Bird *et al.* 2010) on the role of education in supporting resilience in conflict-affected Northern Uganda (2010), a study by Miller *et al.* (2011) which examines the role of asset inheritance in the IGT of poverty in rural Kenya and a study of maternal health and education and child outcomes in Guatemala by Behrman *et al.* (2010).

Qualitative research can be useful in exploring the IGT of poverty (Bird, 2010b; da Corta, 2007a; Miller, 2007). Life history and family history interviews, which enable a qualitative exploration of the life-course of an individual or a family, have been found to be very effective. Bird (2010b) outlines the power of life history interviews in analysing and understanding the IGT of poverty and resilience. The study shows that life histories are capable of identifying changes in well-being during the life-course and recounting the factors contributing to upward and downward mobility.

Miller (2007) argues that family histories are a useful addition to the methodological toolbox for understanding the IGT of poverty. More specifically, this study proposes a method of collecting family histories which links households from panel studies with individual life histories. The study also contends that family histories can augment panel studies by placing quantitative findings in context; extending household panel data to households and individuals within the same family but located separately; and increasing the period covered by panel data through the retrospective recall of events.

Da Corta (2007b) offers an approach to semi-structured interviewing that can support research on the IGT of poverty. Specifically, this paper illustrates how ***recall methods*** can help people's memories and enable them to date, rank and quantify historical data. Such methods enable the construction of panel-type data where a panel does not exist, and allow researchers to link individuals or households in the panel to their accounts of changes in their poverty status and the social relations that underpin such poverty. Da Corta suggests that recall methods might be useful in the study of the IGT of poverty by creating a multigenerational data panel "from scratch", by completing existing panel datasets by enhancing the range of variables or extending existing surveys back into the past; by complementing good quality panel data by linking a smaller sub-sample to in-depth qualitative life/family history data, and by investigating the deeper historical origins of a process identified in field research. Da Corta clearly outlines how this can be achieved, and how the approach can be

higher chance of poverty in childhood, but also they are more likely to have a lower income as adults (Hobcraft, 1998). As poor parents, they are then more likely to have children born at a lower birth weight and to experience higher infant mortality rates. Their children are more likely to have behavioural problems, less success at school, less opportunity in the labour market and worse health (Halliday and Asthana, 2007; Jenkins and Siedler, 2007).

The determining factors of intergenerational poverty are complex, and often interrelated at both micro and macro levels. "Micro level" here refers to both the individual and the household level, and includes personal choice, motivation, aspiration, capacities, abilities and behaviour, as well as household structures and dynamics. It also includes structural factors, such as gender relations and discrimination, which can affect an individual and/or household. "Macro level" refers to the broader determinants of individuals and households engagement with the wider world, including governmental engagement, the national and local economies and the broader extra-household relationships people have within their community.

3. Methods and Approaches for Understanding the IGT of Poverty: Combining Qualitative and Quantitative Approaches

A focus on methods was seen as important because the absence of high-quality panel data in many low-income developing countries makes the study of the IGT of poverty difficult and necessitates innovative research methods and analytical approaches.

In-depth analysis of the drivers and interrupters of the IGT of poverty requires data tracking of individuals through their life-course, preferably through to the next generation. Researchers generally try to fill this data requirement by analyzing long-run panel data. However, reliable data of this kind are rarely available in low-income developing countries.

A number of specialists were approached and asked to provide insights into alternative approaches to analyzing qualitative and quantitative data. Lucia da Corta (2007) wrote on the way in which individuals' recall of events, facts and figures from their life and livelihood could be strengthened through detailed semi-structured interviewing. Robert Miller (2007) described how family histories could be conducted and how this might be useful for research into the IGT of poverty. Jere Behrman (2006) explored analytical approaches that could be applied to existing micro data in developing countries to examine issues related to the IGT of poverty.

Thus, the time has come to employ a more effective approach in constructing policies and programmes related to poverty which focuses on intergenerational factors rather than on individuals. Despite many policies that focus on the alleviation and reduction of poverty, several elements can influence their effectiveness. One such factor is the (IGT) of poverty.

The main purpose of this paper is to raise awareness about the problem of (IGT) of poverty. In particular, the paper target who are in position to affect policies - including officials from the public sector as well as the media and civil society - and thus act as catalysts in fostering a more focused and robust response to the problem than what has been seen to date in the region. This paper provides an overview of thinking on the intergenerational transmission (IGT) of poverty to define more clearly what we mean by (IGT) of poverty, drawing out the methods and approaches we will use to understand and explain it to guide the thinking of those looking to tackle the problem now, and success will be measured by the extent to which it fosters the political will and consequent pursuit of effective policies that could decisively change the prospects of the next generation of children of the poor in Egypt.

Finally, it reviews briefly the impact of culture of poverty on the transmission of poverty between generations and identifies policy instruments that might possibly break the intergenerational cycle of poverty and provides the experience of Mexico in breaking the cycle of (IGT) of poverty and lessons learned.

2. The Concept of Intergenerational Transmission of Poverty (IGT)

Chronic poverty is a poverty that is pervasive; it affects people for a long time and may even result in premature death. It is different to the kinds of poverty caused by sudden events, such as the loss of a job or the death of a family member, but from which individuals are able to recover over time. Here, we are concerned with the dynamics that lead chronic poverty to extend across generations: some people remain poor for the whole of their lives and "pass on" their poverty to their children and even their children's children. This is known as the intergenerational transmission (IGT) of poverty: it is distinct from child poverty in and of itself, and is a major factor in chronic poverty as opposed to transitory poverty.

Studies on IGT of poverty consider the impact of the poverty of one generation on the poverty of a younger generation, "either at the present (child poverty) or at a future point in their life course" (Bird, 2007). Child poverty, transmitted from the older generation, then continues throughout the life course and on to the next generation. Not only do children with poor parents have a

Intergenerational Transmission of Poverty (IGT): A Concept Paper

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Abstract

This paper provides an overview of the meaning of intergenerational transmission (IGT) of poverty, and seeks to identify gaps in knowledge and to suggest a research in this subject in Egypt. After a general introduction to what we mean by IGT poverty, the paper presents briefly the methods and approaches which used to understand and explain it. We then go on to discuss one of the external factors affecting the transmission of poverty which is the concept of the culture of poverty. The last section discusses, in general how to break the intergenerational cycle of poverty and provides a case study.

Keywords: intergenerational transmission of poverty (IGT), panel data, qualitative analysis, quantitative analysis, culture of poverty, cycle of poverty.

1. Introduction

Intergenerational transmission (IGT) of poverty is the process by which poor parents pass on poverty and disadvantage to their children. It is the result of interplay between certain conditions that characterize the lives of worrying percentage of household around the world. IGT of poverty negates equality of opportunities at birth, and in so doing impairs the basis for a fair society and for social stability. It erodes social cohesion and fuels violence particularly, in the context of Egypt's current economic stress. By severely diminishing opportunities for the children of the poor to build their human capital, IGT of poverty hobbles a country's future productivity and with that, its prospects for growth and development. By perpetuating an underclass of families without effective access to sources of human capital and consequent earning power, IGT of poverty is a powerful force behind Egypt's unequal income distribution.

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significantly higher intensity of transition between CKD stage IV and ESRD compared with females.

Analyzing the behavior of patients according to their palace of residence showed important nevertheless expected results. Patients from Upper Egypt show the fastest rates of transition among CKD stages compared to patients from Lower Egypt, Giza and Cairo. This may be explained in terms of the allocation of health facilities among different regions of Egypt and how easy the access to the available facilities.

No previous studies investigated the effect of age of patient when first diagnosed on his transition probabilities however it may be of great importance. The researcher made a trial to include the age effect into the model and estimate its effect. The estimation algorithm did not converged to good estimates. This may be due to the limited data size which did not allow estimating double the number of parameters.

Grouping patients according to age when first diagnosed into three subgroups allows comparing transition intensities and behavior of patients of different age groups. The results were reasonable since patients of older ages have the fastest rate of transition between CKD successive stages. This may be due to the overall deterioration in health status and the existence of other chronic diseases among elderly cohorts of patients. Here, the role of other chronic disease emerged to be important to be analyzed.

This study concentrates on analyzing how HTN and DM affect the natural course of CKD. DM is shown to affect the transition intensities more powerfully than HTN. DM as a risk factor was addressed in number of studies (Hamer and ElNahas, 2006, Ornaldo et al., 2011, Icks et al., 2011, Begun et al., 2012). Results also show that having more than one chronic disease lead to a faster deterioration of kidney function and a greater risk to develop ESRD.

Further researches may include variables such as age at onset and the cause of CKD into CKD model. The measurement errors of GFR level may be treated in further studies using appropriate models with classification errors. Representative data of CKD patients in Egypt is needed for purposes of generalizing results, planning and policies.

In conclusion, the study develops a model to represent CKD natural progression course and shows how this model may be applied empirically using real case-study data. Model parameters are estimated efficiently using the maximum likelihood method. The results were reasonable and consistent. CTMC is a cornerstone for more advanced models.

Discussion:

Chronic diseases represent a major concern to health policy and planning, especially in developing countries. When a disease is detected at an early stage, it may be more amenable to treatment (Jackson et al., 2003). Knowledge about the progression of chronic diseases is important because it may help health policy makers to evaluate expected burden of disease in future and to evaluate cost effectiveness of competing interventions. The Markov Chain approach is often used for analyzing progression of diseases by describing the time evolution of an individual in the multistate model (Begun et al., 2012).

CTMC is more appropriate than discrete-time Markov Chain for studying patient progression through successive stages of a chronic disease where transitions may be slow, therefore have small probabilities and cannot be described accurately in discrete time units. Kolmogorov's differential equation plays a key role in defining uniquely CTMC. The solution of Kolmogorov's differential equation depends on the form of the generator matrix of the model. For simpler forms of the generator matrix, the analytical solution of Kolmogorov's forward system of differential equation is attainable. The resulting mathematical relations between the probability of transition and rate of transition can be used to formulate a likelihood function of transitions, then estimating the elements of the generator function which is the model parameters (Anwar and Mahmoud, 2014).

Kalbfleicsh and Lawless in 1985, and recently Jackson in 2011, presented a general methods for evaluating the likelihood for general multistate model in continuous time depending on the form of the transition probability matrix.

The results of this research describe the natural progression of CKD in a case-study sample of CKD patients and the results are not generalizable. Limited number of researches studied the natural progression of CKD specially from its early stages. Most estimates are population-based and cannot be generalized among other societies.

Regarding the consistency of the results of this research, it have an internal consistency with study assumptions along with an external consistency with results from previous literature. The probability of transition increases as the severity of CKD increases and the risk of developing renal failure increases with the severity of stage where the patient was first diagnosed. We also compared the transition probability and the risk of developing ESRD among different subgroups. The results seem very reasonable since it consist with results from previous literature (Scheipatti and Remuzi, 2005, Hamer and ElNahas, 2006, Sharadanballal, 2007, Begun et al., 2012). Previous studies showed that males have a higher probabilities to develop ESRD if compared to females. Our results show that males have a

Figure (8): Probability of Transition between CKD Stages According to Whether the Patient has both HTN and DM.

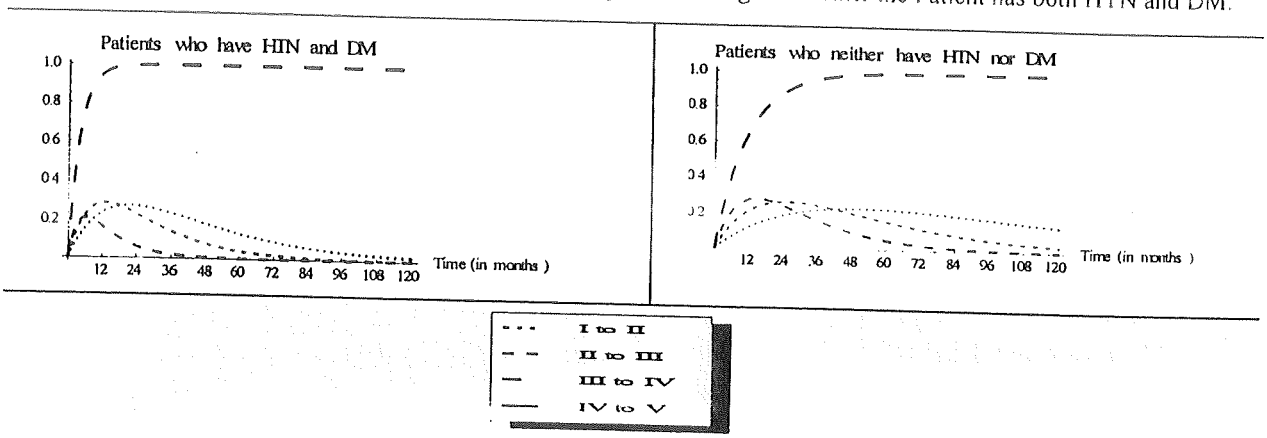


Table (26) shows the mean sojourn time in CKD stages according to whether the patient has both HTN and DM. it is clear that having HTN and DM strongly shorten the time of stay in all stages of CKD.

Table (26): Mean Time of Stay (in months) in CKD Stages According to Whether the Patient has HTN and DM.

HTN and DM \ CKD Stage	I	II	III	IV
Yes	28.57	16.67	10.53	4.00
No	76.92	34.48	18.86	11.36

Under the same assumptions of closed cohorts and the same equilateral initial distribution of patients among CKD stages for CKD patients with HTN and DM and without them, we can notice that the distributions of the cohorts of patients after one year are different. (see Table (27))

Table (27): Percentage Distribution of Cohorts of Patients, According to Whether the Patient has HTN and DM, among CKD Stages after One Year.

HTN and DM \ CKD Stage	I	II	III	IV	V
Yes	13.1	14.5	16.9	6.5	49.0
No	17.1	16.6	16.6	13.7	36.0

Table (28) shows that patients with HTN and DM have expected time to absorption lower than that of patients without them. The gap is too wide in mild stages rather than in more severe stages.

Table (28): Expected Time to Absorption (in months) of CKD Stages According to Whether the Patient has HTN and DM.

HTN and DM \ CKD Stage	I	II	III	IV
Yes	28.7	17.0	10.8	4.00
No	77.0	34.6	19.0	11.36

Table (24) shows that patients with DM have expected time to absorption lower than that of patients without DM especially those that have been first diagnosed in more severe stages.

Table (24): Expected Time to Absorption (in months) of CKD Stages According to Whether the Patient has DM.

DM \ CKD Stage	II	II	III	IV
Yes	33.5	18.8	12.0	4.75
No	62.6	31. 5	19.3	12.10

In order to investigate the effect of having more than one chronic disease on CKD progression, the researcher compared the estimated transition intensities between two groups of patients; patients who have both HTN and DM versus patients who haven't neither HTN nor DM. The maximum likelihood estimates and standard errors are presented in Table (25).

It is clear that having HTN and DM accelerates the transition intensities between all CKD successive stages. Patients who have both HTN and DM have a statistically significant higher intensities of transition between CKD successive stages. The effect of both HTN and DM is highest on the transition intensity from stage IV to ESRD since the intensity of transition of the group of patients with both HTN and DM approximately equals 3-fold of which of patients with neither HTN nor DM.

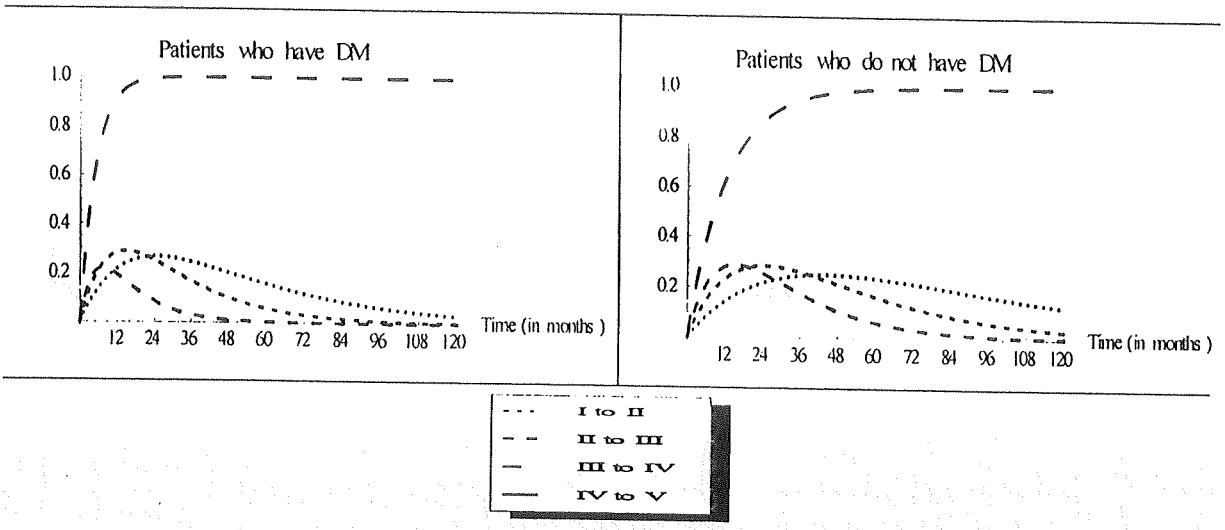
Table (25): Maximum Likelihood Estimates of Transition intensities between CKD Stages and Their Standard Errors According to Whether the Patient has HTN and DM.

HTN and DM \ Transition	I-II	II-III	III-IV	IV-V
Yes	0.035 (0.0132)	0.060 (0.0190)	0.095 (0.0222)	0.250 (0.0547)
No	0.013 (0.0036)	0.029 (0.0075)	0.053 (0.0125)	0.081 (0.0220)

*: Estimates, followed by standard errors given in parentheses.

Figure (8) shows the difference in the behavior of the two groups of patients with respect to their probability of transition between CKD successive stages. Percentage of patients with HTN and DM who moved from stage I to stage II during one year is approximately 2 times the percentage of patients without HTN or DM.

has DM.



Unlike HTN, the effect of DM is more clear on late stages rather than earlier stages of CKD. Percentage of patients with DM who moved from stage IV to stage V during one year approximately 1.5 times that of patients without DM.

Table (22) show the mean sojourn time in CKD stages according to whether the patient has DM. it is clear that DM shorten the time of stay in all stages of CKD.

Table (22): Mean Time of Stay (in months) in CKD Stages According to Whether the Patient has DM.

DM \ CKD Stage	I	II	III	IV
Yes	33.34	18.52	11.76	4.75
No	62.50	31.25	12.05	12.10

Under the assumptions of closed cohorts and the same equilateral initial distribution of patients among CKD stages $\Pi(t = 0) = (0.2 \quad 0.2 \quad 0.2 \quad 0.2 \quad 0.2)$ for CKD patients with and without DM, the distributions of the two cohorts of patients after one year are shown in Table (23).

Table (23): Percentage Distribution of Cohorts of Patients, According to Whether the Patient has DM, among CKD Stages after One Year.

DM \ CKD Stage	I	II	III	IV	V
Yes	13.9	14.8	17.2	7.5	46.6
No	16.5	16.5	18.0	14.3	34.7

Under the assumptions of closed cohorts and the same equilateral initial distribution of patients among CKD stages $\Pi(t = 0) = (0.2 \quad 0.2 \quad 0.2 \quad 0.2 \quad 0.2)$ for CKD patients with and without HTN, we can notice that the distributions of the two cohorts of patients after one year are different especially regarding the percentage of patients in stage I . (see Table (19))

Table (19): Percentage Distribution of Cohorts of Patients, According to Whether the Patient has HTN, among CKD Stages after One Year.

HTN \ CKD Stage	I	II	III	IV	V
Yes	13.9	15.3	17.6	13.1	40.1
No	16.9	14.9	17.9	14.0	36.3

Table (20) shows that patients with HTN have expected time to absorption lower than that of patients without HTN.

Table (20): Expected Time to Absorption (in months) of CKD Stages According to Whether the Patient has HTN.

HTN \ CKD Stage	II	II	III	IV
Yes	33.50	19.81	12.50	8.33
No	71.52	25.87	17.95	11.11

DM has more powerful effect on the progression of CKD on the light of the results of the current study's sample. Its effect is statistically significant at 0.95 level of significance on all of the estimated transition rates between all successive stages of CKD. Regarding the intensity of transition from IV to V, patients with DM have transition rate equals 2.5 times that of patients without DM. This result is consistent with results from previous literature which showed that Diabetes increases the intensity of transition from CKD stage IV to ESRD (Begun et al., 2012).

Table (5.22): Maximum Likelihood Estimates of Transition intensities between CKD Stages and Their Standard Errors* According to Whether the Patient has DM.

DM \ Transition	I-II	II-III	III-IV	IV-V
Yes	0.030 (0.0064)	0.054 (0.0086)	0.085 (0.0128)	0.21 (0.0400)
No	0.016 (0.0034)	0.032 (0.0051)	0.052 (0.0076)	0.083 (0.0123)

*: Estimates, followed by standard errors given in parentheses.

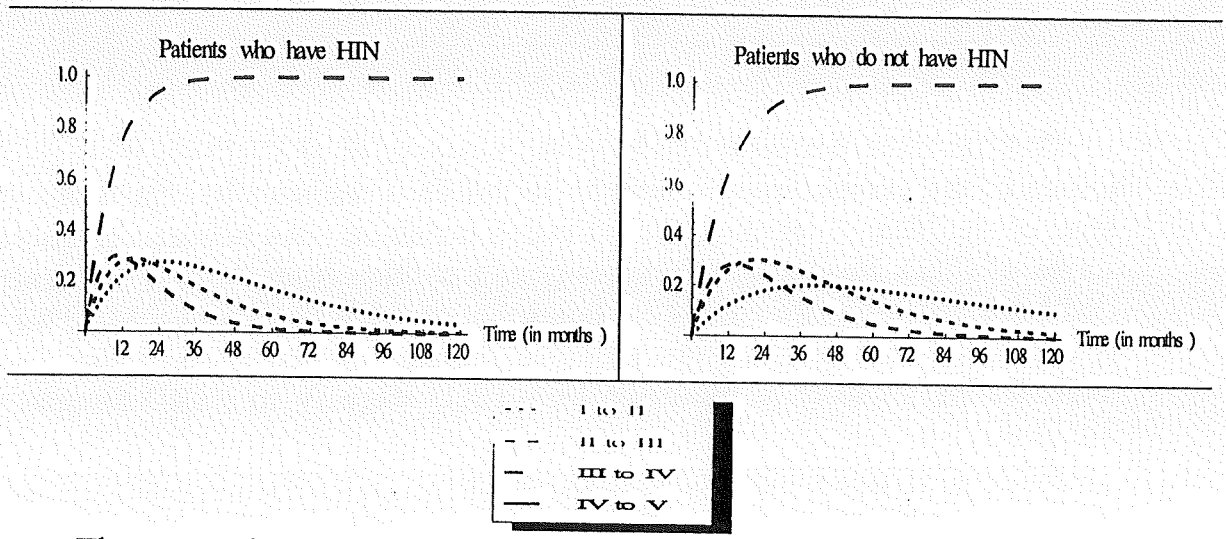
Figure (7) shows the probability of transition between CKD successive stages according to whether the patient has DM. It can be noticed that DM increases the probability of transition between of CKD successive stages.

Figure (7): Probability of Transition between CKD Successive Stages According to Whether the Patient

Form Table (17), it can be deduced that HTN has an effect on the rate of transition between CKD successive stages. Its effect is significant at 0.95 level of significance on the estimated transition rate from stage I to stage II while its effect on the other transitions is statistically insignificant. This is seem consistent with previous results which highlighted HTN as an important initiator of CKD, so it may have powerful effect on transition between mild stages rather than severe stages.

It can be noticed from Figure (6) that HTN increase the probability of transition between of CKD successive stages especially the transition from stage I to stage II since the percentage of patients with HTN who moved from stage I to stage II during one year is approximately two times the percentage of patients without HTN. It can also be noticed that HTN have no clear effect on the behavior of patients among the CKD stages III, IV and V.

Figure (6): Probability of Transition between CKD Successive Stages According to Whether the Patient has HTN.



The mean time of stay in CKD stages according to whether the patient has HTN also stresses on its effect on the transition between the first two stages of CKD. The gap between the mean time of stay in stage I between patients with HTN and patients without HTN are the largest among all stages of CKD.

Table (18): Mean Time of Stay (in months) in CKD Stages According to Whether the Patient has HTN.

HTN \ CKD Stage	I	II	III	IV
Yes	33.33	19.61	12.35	8.33
No	71.42	25.64	17.86	11.11

It can be noticed from Table (15) that the percentage of patients above 60 in ESRD after one year is higher than that of patients from other age groups. This result is logical and consistent with what is mentioned in previous literature.

Table (15): Percentage Distribution of Cohorts of Patients, According to Age* of Patient, among CKD Stages after One Year.

Age \ CKD Stage	I	II	III	IV	V
Less than 40	15.9	16.4	18.0	14.5	35.2
40 – 60	15.5	16.2	16.4	16	35.9
Above 60	13.9	15.3	20.0	14.6	36.2

*: Age of Patient when first diagnosed

Table (16) shows that patients above 60 show the lowest expected time to absorption while patients less than 40 show the highest time to absorption. The gap between them becomes narrower as we move to stages III and IV. This suggests that the behavior of patients in severe stages does not vary according to age of patient when he/she was first diagnosed as CKD patient.

Table (16): Expected Time to Absorption (in months) of CKD Stages According to Age* of Patient.

Age \ CKD Stage	II	II	III	IV
Less than 40	52.7	28.7	17.7	11.6
40 – 60	47.8	26.5	14.7	12.1
Above 60	33.5	19.8	14.2	10

*: Age of Patient when first diagnosed

Fourth: Existence of other Chronic Diseases

Previous studies showed that the existence of other chronic disease may contribute to the initiation and progression of CKD. HTN and DM, with both types I and II, are from the important etiologies and risk factors of CKD. Estimates of transition intensities were calculated for patients according to the existence of other chronic disease. Patients were classified according to whether he/she has HTN and DM. The maximum likelihood estimates and their standard errors are estimated and presented in Tables (17) and (21).

Table (17): Maximum Likelihood Estimates of Transition intensities between CKD Stages and Their Standard Errors* According to Whether the Patient has HTN.

HTN \ Transition	I-II	II-III	III-IV	IV-V
Yes	0.030 (0.0075)	0.051 (0.0087)	0.081 (0.0118)	0.120 (0.0160)
No	0.014 (0.0037)	0.039 (0.0088)	0.056 (0.0110)	0.090 (0.0218)

*: Estimates, followed by standard errors given in parentheses.

Figure (5): Probability of Transition between CKD Successive Stages According to Age of Patient.

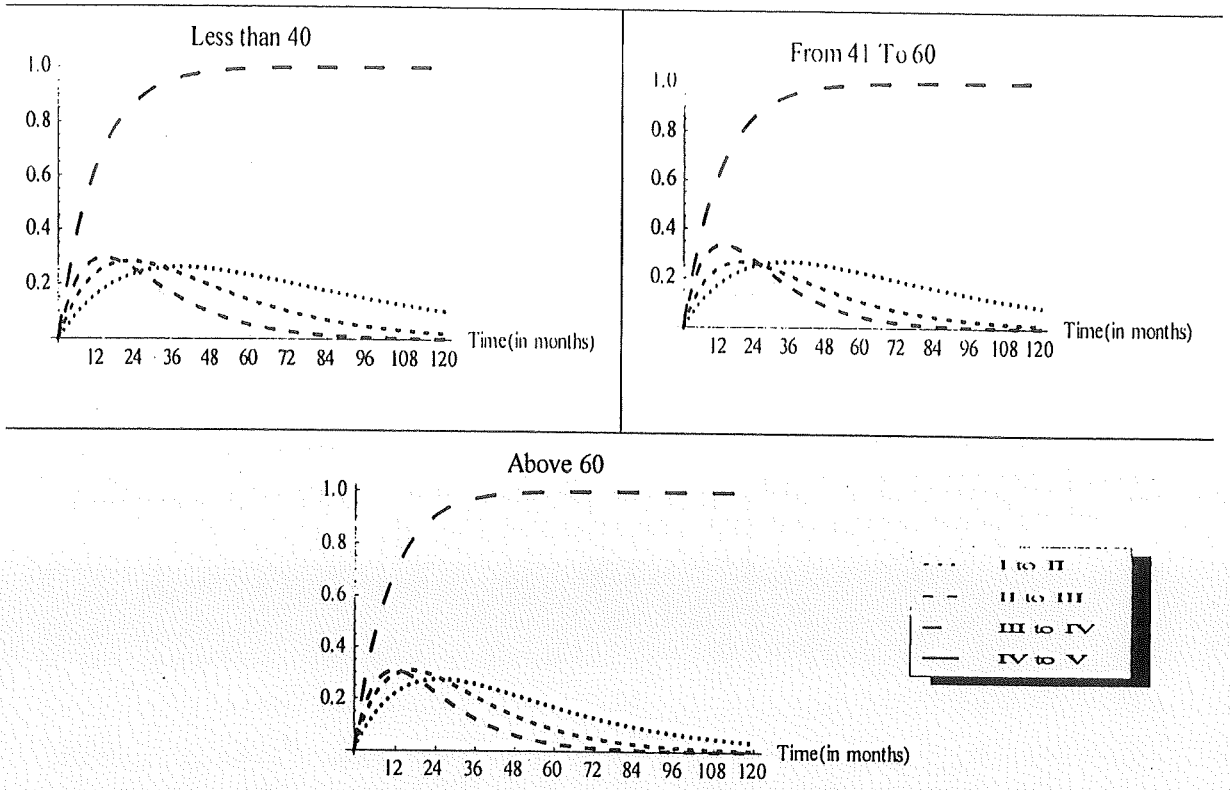


Table (14) shows the expected duration of stay in CKD different stages for the three groups of patients. It can be noticed that age of patient has a negative relationship with the mean time of stay in CKD stages. Patients less than 40 and 40-60 have a very close mean time of stay in stage IV, while patients 40-60 and above 60 have a very close mean time of stay in stage III.

Table (14): Mean Time of Stay (in months) in CKD Stages According to Age* of Patient.

Age \ CKD Stage	I	II	III	IV
Less than 40	52.6	28.6	17.5	11.6
40 – 60	47.6	26.3	14.5	12.1
Above 60	33.3	19.6	14.1	10.0

*: Age of Patient when first diagnosed

Under the assumptions of closed cohorts and the same equilateral initial distribution of patients among CKD stages $\Pi(t = 0) = (0.2 \quad 0.2 \quad 0.2 \quad 0.2 \quad 0.2)$ for CKD patients from different Age groups, we can notice that the distributions of these cohorts of patients after one year are different. (see Table (15))

compared with younger patients?". The maximum likelihood estimates and their standard errors are estimated and presented in Table (13).

It can be noticed from Table (13) that patients who were diagnosed as CKD patients at younger ages have the slowest rates of transition between CKD stages. On the other hand patients who were diagnosed at older ages have higher rates of transition. This may be due to the overall deterioration in health related to aging.

Figure (5) presents the probability of transition between successive stages of CKD according to age of patient when he/she was first diagnosed as a CKD patient. It can be noticed that there is no statistically significant difference between the behavior of the three groups of patients with respect to their probability of transition between CKD stages.

Table (13): Maximum Likelihood Estimates of Transition intensities between CKD Stages and Their Standard Errors* According to Age of Patient.

Age** \ Transition	I-II	II-III	III-IV	IV-V
Less than 40	0.019 (0.0055)	0.035 (0.0097)	0.057 (0.0190)	0.086 (0.0200)
40 – 60	0.021 (0.0061)	0.038 (0.0069)	0.069 (0.0110)	0.083 (0.0140)
Above 60	0.030 (0.0100)	0.051 (0.0130)	0.071 (0.0130)	0.100 (0.0190)

*: Estimates, followed by standard errors given in parentheses.
**: Age of Patient when first diagnosed

All of the three age groups have the same pattern of transition between CKD stages as we can notice that the more severe the stage the faster the transition. Patients above 60 years of age have the highest probabilities of transition if compared with patients from other age groups. It can be noticed that 22.2% of patients above 60 moved from stage I to stage II during one year while this percentage decrease for patients aged (40-60) and (Less than 40) since it equals 17.6 and 16.4 respectively. The gap between percentages of patients moved between CKD stages becomes wider if we compare it within the mildest stages and the most severe stages since 70% of patients above 60 moved from stage IV to ESRD during one year while 64% of patients aged (40-60) and 63.1% of patients aged (Less than 40) moved from stage IV to ESRD during the same period of time.

Table (10): Mean Time of Stay (in months) in CKD Stages According to Patient's Place of Residence.				
Place of Residence \ CKD Stage	I	II	III	IV
Cairo	58.8	27.8	14.7	12.1
Giza	38.5	20.0	12.5	10.0
Upper Egypt	32.3	18.5	11.6	10.0
Lower Egypt	37.0	20.8	14.1	11.1

Under the assumptions of closed cohorts and the same equilateral initial distribution of patients among CKD stages $\Pi(t = 0) = (0.2 \quad 0.2 \quad 0.2 \quad 0.2 \quad 0.2)$ for CKD patients from different places of residence, we can notice that the distributions of the cohorts of patients after one year are different. (see Table (11))

Table (11): Percentage Distribution of Cohorts of Patients, According to Place of Residence, among CKD Stages after One Year.					
Place of Residence \ CKD Stage	I	II	III	IV	V
Cairo	16	16	16	16	36
Giza	15	15	17	15	38
Upper Egypt	14	15	17	16	38
Lower Egypt	14	15	19	16	36

It can be noticed from Table (12) that patients from Upper Egypt show the lowest expected time to absorption. This is true regarding stages I, II and III, while their expected time to absorption given that they are in stage IV equals that of patients from Giza.

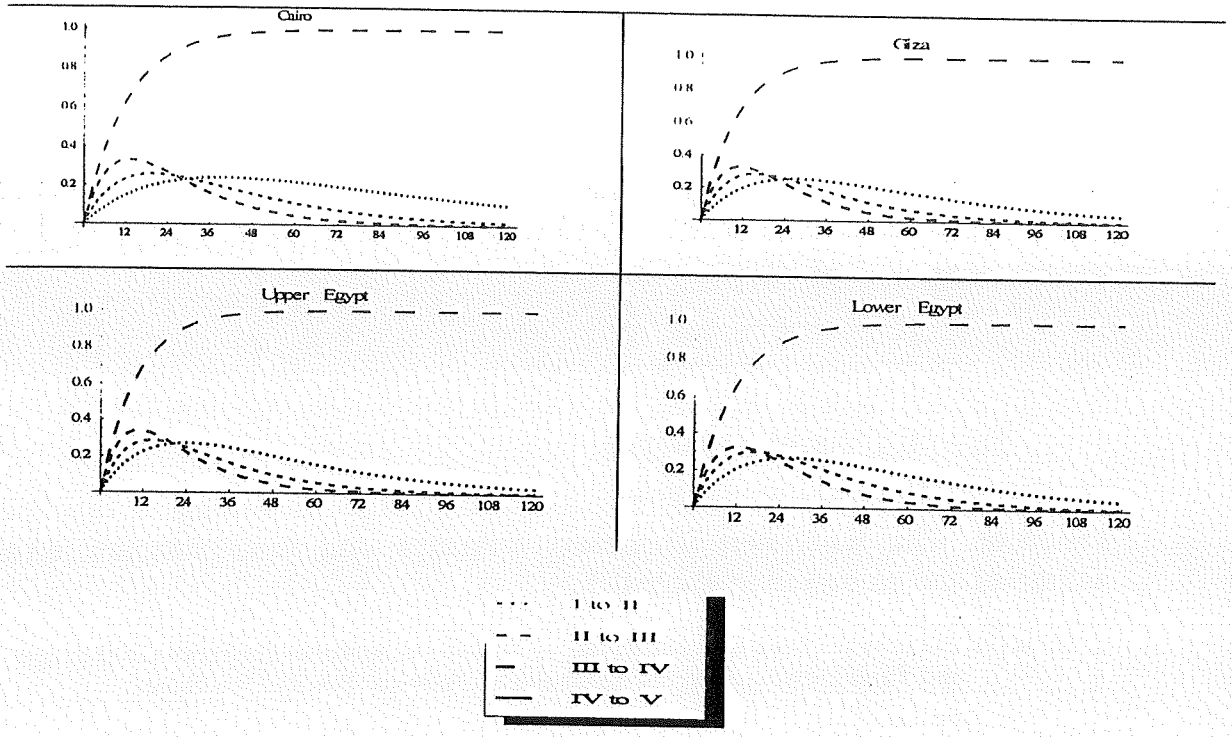
Table (12): Expected Time to Absorption (in months) of CKD Stages According to Patient's Place of Residence.				
Place of Residence \ CKD Stage	II	II	III	IV
Cairo	59.0	28.0	14.8	12.1
Giza	38.8	20.3	12.6	10.0
Upper Egypt	32.5	18.8	11.7	10.0
Lower Egypt	37.2	21.0	14.2	11.1

Third: Age of Patient when first diagnosed

Age of patients when first diagnosed may have an impact on their response to treatment and so on their probability of transition between CKD successive stages. Patients were classified into three groups according to their age when first diagnosed. This is in order to reply to an important question "Do elder patients are more likely to have a faster rate of transition to more severe CKD stages if

differences between the estimates of transition intensities are not statistically significant at 0.95. Patients from Upper Egypt shows the fastest transitions among CKD stages. Patients from Giza and Upper Egypt show a statistically significant faster rate of transition from IV to V than patients from Cairo at 0.95 level of significance. Here, it may be important to note that almost all patients from rural areas reside either in rural Giza or rural Upper Egypt, this may explain the faster intensity of transition from IV to V in Giza and Upper Egypt.

Figure (4): Probability of Transition between CKD Successive Stages According to Place of Residence



For the first transitions, patients from Upper Egypt are the fastest than patients from other places since about 22.4% of them are moved from stage I to stage II during one year while this percentage decreases to 20% for patients from Lower Egypt, 19% for Patients from Giza and about 15% for patients from Cairo. Patients from Cairo are the slowest in all transitions. This may be due to that patients in Cairo have better access to health care facilities compared to other regions of Egypt.

Table (10) shows that patients from Cairo stay longer than other patients in earlier stages of the disease while patients from all regions have approximately the same duration of stay in more sever stages of the disease with patients from Upper Egypt has notable short stays in all CKD stages.

Table (7): Percentage Distribution of Male Cohort and Female Cohort among CKD Stages after One Year.					
Sex \ CKD Stage	I	II	III	IV	V
Males	14.8	15.5	19.1	15.1	35.5
Females	16.3	15.3	15.8	14.0	38.6

It can be noticed from Table (7) that Percentage of females at ESRD after one year is higher than that of males. It is also noticed that the new comers females to ESRD are from near stages (6% from stage IV and 4.2% from stage III) while the behavior of males is different from that of females (4.9% from stage IV and only 0.9% from stage III).

The expected time to absorption is estimated to both sexes of patients and is showed in Table (8).

Table (8): Expected Time to Absorption (in months) of CKD Stages According to Sex of Patients.				
Sex \ CKD Stage	I	II	III	IV
Males	41.0	22.0	15.2	10.9
Females	59.0	25.5	14.4	10.0

Second: Place of Residence

CKD patients were distributed into four groups according to their place of residence. The maximum likelihood estimates and their standard errors are estimated and presented in Table (9).

Table (9): Maximum Likelihood Estimates* of Transition intensities between CKD Stages and Their Standard Errors According to Patients' Place of Residence.				
Place of Residence \ Transition	I-II	II-III	III-IV	IV-V
Cairo	0.017 (0.0039)	0.036 (0.0044)	0.068 (0.0058)	0.083 (0.0062)
Giza	0.026 (0.0085)	0.050 (0.0084)	0.080 (0.0083)	0.100 (0.0018)
Upper Egypt	0.031 (0.0114)	0.054 (0.0148)	0.086 (0.0294)	0.100 (0.0030)
Lower Egypt	0.027 (0.0134)	0.048 (0.0181)	0.071 (0.0254)	0.090 (0.0412)
*: Estimates, followed by standard errors given in parentheses.				

Figure (4) presents the probability of transition between successive stages of CKD according to patients' place of residence. It can be noticed that there is no clear differences between the behavior of the four groups of patients. The

Figure (3) presents the probability of transition between successive stages of CKD according to patients' sex. It can be noticed that there is no statistically significant difference between the behavior of male patients and female patients with respect to their intensity of transition between CKD stages; I to II, II to III, III to IV except their intensity of transition from IV to V at 0.99 level of significance.

For the first two transitions, males are faster than females since about 20% of males are moved from stage I to stage II during one year while this percentage decreases to 14% for females. About 29% of males who are in stage II will be in stage III within one year while only 25% of females will transit. Regarding the last two transitions, there is approximately no difference between the behavior of patients of both sexes.

Figure (3): Probability of Transition between CKD Successive Stages According to Sex of Patients

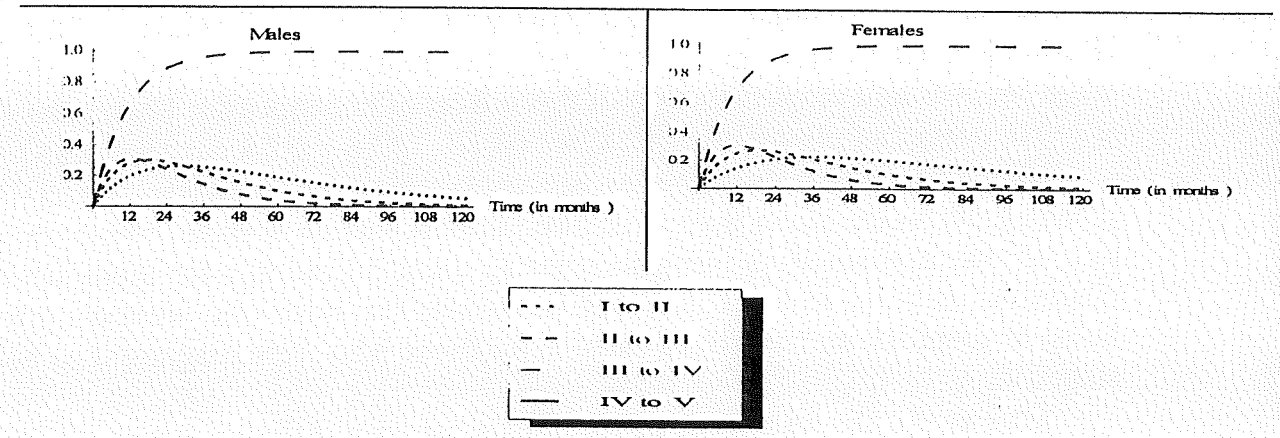


Table (6) shows that female patients stay longer than males in earlier stages of the disease while both sexes has approximately the same duration of stay in more sever stages.

Table (6): Mean Time of Stay (in months) in CKD Stages According to Sex of Patients.

Sex \ CKD Stage	I	II	III	IV
Males	40.0	22.0	15.0	10.9
Females	58.0	25.0	14.3	10.0

If we assume the same equilateral initial distribution of patients among CKD stages $\Pi(t = 0) = (0.2 \quad 0.2 \quad 0.2 \quad 0.2 \quad 0.2)$ for both sexes, we can notice that the distribution of these two cohorts of patients after one year will be different. (see Table (7))

The mean time spent by a CKD patient in state 1 approximately equals 46 months, while it decreases in state 2 to be about 28 months. The deterioration in health state of a CKD patient becomes rapid in more severe stages than mild stages since the mean time spent by a patient in states 3 and 4 of the system is about 17 and 12 months respectively.

Another important concept of CTMC is the state probability distribution. The state probability distribution of CKD process, sometimes known by the marginal distribution is calculated to find out the expected distribution of patients among CKD stages at a specific time point t in the future. This is under the assumption of a closed cohort. Let us assume that the state probability distribution, of the process at time t is $\Pi(t)$. Then, $\Pi(t)$ can be evaluated by solving the following equations:

$$\Pi'(t) = \Pi(t) \times V \qquad (14)$$

with the initial condition $\Pi(0) = (\pi_{01} \quad \pi_{02} \quad \pi_{03} \quad \pi_{04} \quad \pi_{05})$

Let us assume that the initial distribution of patients among CKD stages $\Pi(t = 0) = (0.2 \quad 0.2 \quad 0.2 \quad 0.2 \quad 0.2)$, the likelihood to remain in the same stage declines and the distribution of this cohort of patients after 12 months will be approximately as follows: $\Pi(t = 12) = (0.15 \quad 0.16 \quad 0.18 \quad 0.15 \quad 0.35)$.

Estimating the mean time to absorption may be important specially for planning purposes. Mean time to absorption of a patient is about 50 months given that he was diagnosed as being in stage I, about 30 months for those who were diagnosed as being in stage II, about 19 months for those who were diagnosed as being in stage III, and nearly 12 months for those who were diagnosed as being in stage IV.

Afterwards, the intensities of transitions between different stages of CKD are estimated according to different characteristics of patient (demographic and medical) in order to get a clue about the determinants of disease progression speed in Egypt.

First: Sex of Patients

The maximum likelihood estimates of the models parameters $\lambda_{ij}'s$ of Males and Females were estimated separately and their standard errors were calculated as well. Estimates of transition rates and standard errors are presented in Table (5).

Table (5): Maximum Likelihood Estimates of Transition intensities between CKD Stages and Their Standard Errors According to Sex of Patients.

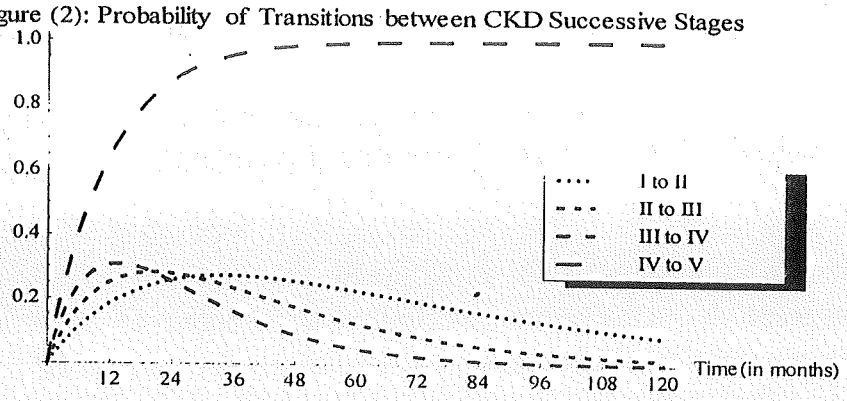
Sex \ Transition	I-II	II-III	III-IV	IV-V
Male	0.025 (0.0065)	0.046 (0.0097)	0.066 (0.0100)	0.091 (0.0150)
Female	0.017 (0.0040)	0.040 (0.0047)	0.070 (0.0055)	0.100 (0.0015)

*: Estimates, followed by standard errors given in parentheses.

After the instantaneous rate of transition between CKD stages, λ_{ij}'s, are estimated, one can calculate the probability of transition between different stages. Figure (2) shows the probability of transition between successive stages of CKD.

The probability of transition between successive stages, in the beginning, increases with time then it adheres some kind of stability for a short time interval and finally it decreases with time. Transition from stage IV to V shows different behavior. The probability of transition from stage IV to V increases with time during the first five years then it equals 1 and doesn't change with time. This is because the stage V, ESRD, is absorbing.

Figure (2): Probability of Transitions between CKD Successive Stages



The probability of transition from I to II shows slow increase with the first 24 months if compared with probability of other transitions, while probability of transition between the other stages show sharp rise during the first 12 months with notable rise in the probability of moving from IV to V. The gap in probability between the last transition and the others is huge.

It can also be concluded that the higher the stage order the higher the probability of moving to the next stage for the first 24 months.

From figure (2), one can observe that about 18.2 % of patients who are in stage I will be in stage II within one year, 25% of Stage II patients will move to stage III within one year, 31% of the patients who are in stage III will move stage IV within one year, while about 65% of Stage IV patients will be in Stage V within one year, hence require any type of RRT.

Since CKD is an irreversible and progressive disease, the patient is not supposed to have many visits to a single stage after moving to other stages. Mean sojourn time which describes the expected duration of a single stay in a state, here is equivalent to the total length of stay in a state. It is assumed that the sojourn times $e_j's$ are independent and exponentially distributed random variables with mean $\frac{1}{\lambda_j}$ where $\lambda_j = -\lambda_{jj}$ for $j = 1, \ldots, 4$.

methods for evaluating the likelihood for general multi-state model in continuous time, applicable to any form of transition matrix (Kalbfleisch and Lawless, 1985, Kay, 1986, Mandel, 2010, Jackson, 2011). The likelihood is calculated from the transition probability matrix $P(t)$ that is expressed in terms of the transition intensity matrix V. The likelihood for intermittently observed process may be summarized in the following steps:

- For a pair of successive observed disease states $S(t_j), S(t_{j+1})$ at times t_j, t_{j+1}. The contribution to the likelihood from this pair of states is

$$L_{i,j} = p_{S(t_j)S(t_{j+1})}(t_{j+1} - t_j) \quad (12)$$

This is the entry of the transition matrix $p(t)$ at the $S(t_j)^{\text{th}}$ row and $S(t_{j+1})^{\text{th}}$ column, evaluated at $t = t_{j+1} - t_j$.

- The full likelihood is then the product of probabilities of transition between observed states, over all individuals i and observation time j:

$$L(V) = \prod_i L_i = \prod_{i,j} L_{i,j} = \prod_{i,j} p_{S(t_j)S(t_{j+1})}(t_{j+1} - t_j) \quad (13)$$

The likelihood $L(V)$ is maximized in terms of $log(\lambda_{ij})$ to compute the estimates of λ_{ij}. Often, the maximization process of such likelihood function utilizes a numerical algorithms that require no derivatives of the function such as The Quasi-Newton algorithm, Nelder-Mead algorithm and many others.

Application:

The maximum likelihood estimates of the model parameters $\lambda_{ij}'s$ and their standard errors are estimated and presented in Table (4). The standard errors of $\lambda_{ij}'s$ were calculated using the inverse Hessian matrix at the maximized log-likelihood.

Table (4): Maximum Likelihood Estimates of Transition Intensities between CKD Stages and Their Standard Errors.

Transition	Estimated Value of λ_{ij} (per month)	Standard Errors (per month)
I to II	0.022	0.0041
II to III	0.038	0.0055
III to IV	0.062	0.0074
IV to V	0.087	0.0032

It can be observed from Table (4) that the intensity of transition increases as the severity of illness increases.

Model:

For CTMC's whose transition rate matrix contains a lot of zero elements, it is appropriate to define transition probability functions, $p_{ij}(\tau, t)$, in terms of transition intensities, λ_{ij}, through solving system of Kolmogorov differential equations.

Table (3): Transition Probability Functions that Contribute to the Likelihood of Transitions between CKD Successive Stages.

Transition	Transition Probability Function	
I → I	$P_{11}(\tau,t) = e^{-\lambda_{12}(t-\tau)}$	(3)
I → II	$P_{12}(\tau,t) = \frac{\lambda_{12}}{(\lambda_{23}-\lambda_{12})}\left[e^{-\lambda_{12}(t-\tau)} - e^{-\lambda_{23}(t-\tau)}\right]$	(4)
II → II	$P_{22}(\tau,t) = e^{-\lambda_{23}(t-\tau)}$	(5)
II → III	$P_{23}(\tau,t) = \frac{\lambda_{23}}{(\lambda_{34}-\lambda_{23})}\left[e^{-\lambda_{23}(t-\tau)} - e^{-\lambda_{34}(t-\tau)}\right]$	(6)
III → III	$P_{33}(\tau,t) = e^{-\lambda_{34}(t-\tau)}$	(7)
III → IV	$P_{34}(\tau,t) = \frac{\lambda_{34}}{(\lambda_{45}-\lambda_{34})}\left[e^{-\lambda_{34}(t-\tau)} - e^{-\lambda_{45}(t-\tau)}\right]$	(8)
IV → IV	$P_{44}(\tau,t) = e^{-\lambda_{45}(t-\tau)}$	(9)
IV → V	$P_{45}(\tau,t) = 1 - e^{-\lambda_{45}(t-\tau)}$	(10)
V → V	$P_{55}(\tau,t) = 1$	(11)

The transition probability functions in Table (3) are used to estimate the transition intensities, $\lambda_{ij}'s$, which are the model parameters. Inference and estimation methods depend on the observation scheme.

Panel data yielded from intermittently observed process may be defined as data consisting of snapshots of the process at discrete times on multiple individuals (Lange and Minen, 2013) or in another way, it is data of processes with arbitrary observation times yielded from monitoring disease progression in an incomplete way. For such type of data, patients are usually seen at intermittent follow-up visit, at which monitoring information are collected, but information about the periods between visits is not available, moreover, the exact time of disease onset is unknown (Jackson, 2011).

For Such observation scheme, it is typically to assume that the observed data are generated by a discretely observed CTMC. This family of models enjoys tractable likelihoods and has well established methods of obtaining maximum likelihood estimates for transition intensities. Many authors developed general

Let us also define the transition probability, $p_{ij}(\tau, t)$, which indicates the probability of being in state i at time τ and would be in state j at time t. The transition probabilities $p_{ij}(\tau, t)$ can also be represented in matrix form.

$$P(\tau,t) = \begin{pmatrix} p_{11}(\tau,t) & p_{12}(\tau,t) & p_{13}(\tau,t) & p_{14}(\tau,t) & p_{15}(\tau,t) \\ p_{21}(\tau,t) & p_{22}(\tau,t) & p_{23}(\tau,t) & p_{24}(\tau,t) & p_{25}(\tau,t) \\ p_{31}(\tau,t) & p_{32}(\tau,t) & p_{33}(\tau,t) & p_{34}(\tau,t) & p_{35}(\tau,t) \\ p_{41}(\tau,t) & p_{42}(\tau,t) & p_{43}(\tau,t) & p_{44}(\tau,t) & p_{45}(\tau,t) \\ p_{51}(\tau,t) & p_{52}(\tau,t) & p_{53}(\tau,t) & p_{54}(\tau,t) & p_{55}(\tau,t) \end{pmatrix}$$

The rows of $P(\tau, t)$ should satisfy certain conditions. Its entries are nonnegative and their sum equals to one. The transition probability matrix contains all information necessary to model the movement of a patient among the course of CKD until ESRD.

A CTMC is fully characterized once the transition rate between different states of the system, V, is specified, or conversely when its transition probability matrix is specified along with the expected sojourn time of each state (Lafortune, 2008).

For simpler CTMC's whose transition rate matrix contains a lot of zero elements, it is appropriate to define transition probability functions in terms of transition intensities through solving system of Kolmogorov differential equations.

Kolmogorov's differential equations play central role in the treatment of Markov processes in continuous time. The forward Kolmogorov differential equations (1) describe the probability distribution of a state in time t keeping the initial point fixed by a so-called "last step analysis". On the other hand, the backward Kolmogorov differential equations (2) describes the transition probabilities in their dependence on the initial point i by the "first step analysis".

$$\frac{\partial}{\partial t} P(\tau,t) = P(\tau,t) \times V \qquad (1)$$

with the initial condition

$$P(\tau,\tau) = I$$

where I is the identity matrix. And

$$\frac{\partial}{\partial \tau} P(\tau,t) = -V \times P(\tau,t) \qquad (2)$$

with the initial condition

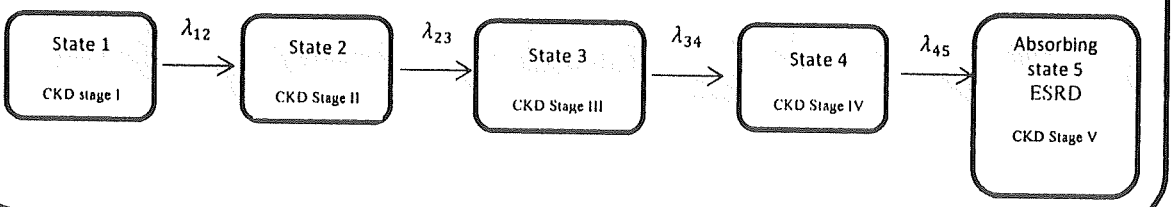
$$P(t,t) = I$$

(Chiang, 1968)

Solving system of forward Kolmogorov differential equations yields into the transition probabilities as functions of λ_{ij}'s which are the model parameters. Those parameters are very essential to the solution of the system.

It is noticed from Figure (1) and from the definition of CKD as a staged progressive irreversible disease that the state space of the progression process is discrete with respect to states and continuous with respect to time. The states of CKD process that will be considered in the study are defined in Table (1).

Figure (1): A 5-state Markov Model for CKD patients



CTMC is appropriate to model CKD since the patient condition deterioration is continuous in time. A CTMC is said to be homogenous in time if the probability of going from one state to another is independent of the time on which the transition occurs. Homogeneity in time holds true for the process of CKD. Hence, one can assume that the finite homogenous continuous-time Markov chain may be an appropriate model of CKD.

Depending on the general illustrative model of CKD progression presented in Figure (1), the transition rate matrix of the CKD Progression Model is as follows:

$$V = \begin{pmatrix} -\lambda_{12} & \lambda_{12} & 0 & 0 & 0 \\ 0 & -\lambda_{23} & \lambda_{23} & 0 & 0 \\ 0 & 0 & -\lambda_{34} & \lambda_{34} & 0 \\ 0 & 0 & 0 & -\lambda_{45} & \lambda_{45} \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

V is a 5×5 matrix, its elements λ_{ij} are the instantaneous rates of transition from one state to another. It can be noticed that λ_{ij} is independent of time because the CKD process is homogenous with respect to time. Sometimes matrix V is called the generator matrix or the infinitesimal matrix. The elements of V are the model's parameters which are population-specific and need to be estimated from data using the appropriate method of estimation.

hemodialysis who preserve a medical file consisting of his past CKD history records and CKD patients who follow up their treatment in one of these clinics are my target group. There were about 310 ESRD patients attending hemodialysis sessions and about 800 CKD patients follow up in Dr. Amr Ayad clinics. Of them, about 550 patients were eligible to my research. Only 160 patients approved to participate in the study. The participants gave their approval to share their data according to a consent provided by the researcher. The field work started in the 10th of February 2014 until the 20th of June 2014.

A total of 148 patients is the sample size of current research with 1290 observation. This application is a case-study. The sample is not representative to the CKD patients in general. The results are not generalizable. Table (2) presents the characteristics of CKD patients of current research.

Table (2): Characteristics of CKD Patients

Demographic		Number	Percentage
Sex	Male	75	50.7
	Female	73	49.3
	Total	148	100.0
Age*	10 – 30	13	8.8
	31 – 50	32	21.6
	51 – 70	80	54.1
	Above 70	23	15.5
	Total	148	100.0
Medical			
CKD Stage**	I	35	23.6
	II	28	18.9
	III	41	27.7
	IV	39	26.4
	V	5	3.4
	Total	148	100.0
DM	Yes	55	37.2
	No	93	62.8
	Total	148	100.0
HTN	Yes	94	63.5
	No	54	36.5
	Total	148	100.0

*: Age of Patient at time of interview
**:CKD Stage when patient first diagnosed.

Stochastic processes modeling approach is utilized to develop a model of the progression of CKD. The general model of disease progression of Jackson *et al.* (2003) can be used to describe the progression of CKD which is defined in terms of staged progressive irreversible deterioration of kidney function. CKD process is illustrated graphically in Figure (1)

Table (1): Stages of CKD		
Stages	**Description**	**GFR** ($mL/min/1.73m^2$)
1	Kidney damage With normal GFR	≥ 90
2	Kidney damage With mild decreased GFR	60-89
3	Moderate decreased GFR	30-59
4	Severe decrease GFR	15-29
5 or ESRD	Kidney Failure	< 15 (or dialysis)
-GFR; glomerular filtration rate: to measure level of kidney function and determine stage of kidney disease. -Chronic Kidney Disease defined as either kidney damage or GFR <60 $mL/min/1.73m^2$ for ≥ 3 months. -Kidney damage is defined as pathological abnormalities or markers of damage, including abnormalities in blood or urine tests or imaging studies.		
Source: K/DOQI Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification, and Stratification, http://www.kidney.org/professionals/kdoqi/guidelines_ckd/toc.html		

In Egypt, There are more than 25000 patients with End-Stage Renal Disease "ESRD" and this number have drastically increased over the latest decades (ERR 9th Annual Report, 2008).

One of the strategies of defeating any chronic disease is to detect it early side by side with the national planning for insuring sufficient treatment of patients. The earlier the CKD is detected the easier to keep the patients in their stages and delaying their transition to a more severe stages using suitable treatments and suitable lifestyle regime. Hence, the overwhelming burden of ESRD on the society and on the budget would be saved.

Few researches studied the incidence and prevalence of ESRD in Egypt (Hussein, M. N., 2003, Kamel, M.A. 2007, Abdel Fatah, S.A., 2009, Barsoum, 1997, 2002,2003) but a very little attention had been given to CKD from Egyptian scientists. Applications of stochastic processes to the control of specific diseases or medical processes have been attempted by number of researchers (Mansour, 1980).

The main goal of the study is to build a stochastic model to represent the progression process of CKD, to estimate the mean time spent in each stage of the disease that precede developing renal failure, and to estimate the state probability distribution, and the mean time to absorption of a CKD patient. This is along with highlighting the modifiable and preventable risk factors that are associated with CKD.

Data and Methods:

Data of CKD patients was collected on the patient-level from 6 specialized centers of renal replacement therapy, "RRT". Patients of ESRD who are on

A Continuous-Time Markov Chain Model for CKD Patients

Noura Anwar[1]

Abstract:

Multistate Markov models are well-established methods for estimating rates of transition between stages of chronic diseases. The objective of this study is to propose a stochastic model that describes the progression process of chronic kidney disease; CKD, estimate the mean time spent in each stage of disease stages that precedes developing end-stage renal failure and to estimate the life expectancy of CKD patients. Continuous-time Markov Chain, CTMC, is appropriate to model CKD. Explicit expressions of transition probability functions are derived by solving system of forward Kolmogorov differential equations. Besides, the mean sojourn time, the state probability distribution, life expectancy of a CKD patient and expected number of patients in each state of the system are presented in the study. An Application on a case-study sample of patients is provided. Finally, concluding remarks and discussion are presented.

Keywords: Chronic Kidney Disease ,Continuous-Time Markov Chain , Expected Time to Absorption, Stochastic Processes, dataset analysis.

Introduction:

The pattern of disease morbidity and mortality throughout the world is changing both in the developed and the emerging countries. During the 20th century, infectious diseases were the major cause of death and disability. However in this century, non-communicable, non-infectious and chronic diseases have become the major cause of morbidity and mortality around the world. (Robert C., 2005)

One of these non-infectious diseases is Chronic Kidney Disease[2] which is defined according to the presence or absence of kidney damage and level of kidney function, irrespective of the type of kidney disease (diagnosis). Among individuals with chronic kidney disease, the stages are defined based on the level of kidney function. CKD is subdivided into five progressive irreversible stages.

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[2] مرض الكلي المزمن

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8.2. Recommendations:

1) The government must exert a great effort to achieve fertility goals of (medium scenario) by adopting suitable population strategy, and this cannot be accomplished easily without cooperation of governmental & nongovernmental organizations in addition to enhance the effectiveness role of the media.
2) The government should encourage and invest in labour intensive projects to absorb a great proportion of upcoming labour force.
3) Increasing the investment in the economy to furnish a huge number of job opportunities.
4) The government should stress on elevating the quality of labour force through education and training.. it should adopt strategy to increase the number of schools, and classes
5) The government should emphasize the quality of education to enhance the skills of its output to suit the labour market needs.
6) Finally, the projected population, labour force and student per class, school, and teacher will be used in economy wide model in order to test the interrelation between population, and economy in our wide study of the PH.D.

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8. Conclusion and Recommendations:

8.1. Conclusion:

Based on the medium scenario (logical scenario), the population will increase by almost 30% during the period(2014-2026) to be 109,459 million person in 2026, and this increase will require several needs for education, health, housing, work opportunities, consumption...etc, which must be satisfied. However, this study focused on the impact of population projection on labour force and education requirements taking account of the new information of TFR in 2014. The above short review in the conclusion just give small portions of labour force and educational needs, we did not review the labour force according economic activities, occupations.... etc, and the same for educational requirements. labor force will increase by almost 30% during the period(2014-2026) to be 35,695 millions in 2026. Female labour force will increase by 67% during the same period to be 10,520 millions in 2026 while male labour force will increase by 18% during the period(2014-2026) to about 25,175 millions in 2026.

Concerning educational needs, the number of public primary schools will increase by 10%, the number of classrooms by almost 44%, and the number of teachers by 24% during the same period. Concerning Azhar primary, we need to increase the number of schools by 40% and the number of classrooms by 50%, and the number of teachers by 27% during the same period. Public preparatory, the number of schools and classrooms should be increasing by 10%, maintain and enhance the quality of teachers during the same period. Concerning Azhar preparatory, the number of schools should increase by 40%, the number of classrooms by 30%, and number of teachers by 8% during the same period. For public secondary, we should increase the number of schools by 72%, the number of classrooms by 19%, and the number of teachers by 11% during the same period. Technical secondary, we should increase the number of schools by 29%, the number of classrooms by 35%, and the number of teachers by 13% during the same period. Concerning Azhar secondary, we should increase the number of schools by 27% during the period(2014-2026), maintain and enhance the available classrooms and teachers in 2012.

7.3.2. Number of the Required Schools, Classes, Teachers for Secondary Education during the Time Period (2014-2026) under Medium Scenario of Fertility:

Table(13) shows that in 2026, the number of schools of public secondary equal 1.72 times the number of schools in 2012 and the number of classrooms equal 1.19 times the number of classrooms in 2012, and the number of teachers almost 1.11 times the number of teachers in 2012. For technical secondary in 2026, the number of schools almost equal 1.29 times the number of schools in 2012 and the number of classrooms equal 1.35 times the number of classrooms in 2012, and the number of teachers 1.13 times the number of teachers in 2012. For Azhar secondary, the number of schools in 2026 equal 1.27 times the number of schools in 2012, and the number of teachers in 2026 equal two thirds the number of teachers in 2012.

Table(13): Number of the Required Schools, Classes, Teachers for Secondary Education during the Time Period (2014-2026) under Medium Scenario of Fertility.

	Year	School Enrolment Rate	Students per Teacher	Students per School	Students per Classroom	Projected Population (16-18)	Students	Required Teachers	Required Schools	Required Classrooms
Public (16-18)		*	Logarithmic R^2=0.78	Logarithmic R^2=0.60	Logarithmic R^2=0.45					
	2014	25.1	11.3	368.5	34.4	4,864,690	1,221,037	108091	3314	35473
	2015	25.1	11.4	359.7	34.2	4,815,117	1,208,594	105641	3360	35326
	2016	25.1	11.6	351.5	34.0	4,782,585	1,200,429	103699	3415	35289
	2017	25.1	11.7	343.8	33.8	4,761,760	1,195,202	102120	3477	35328
	2018	25.1	11.8	336.5	33.7	4,762,335	1,195,346	101088	3553	35516
	2019	25.1	11.9	329.5	33.5	4,808,186	1,206,855	101082	3663	36035
	2020	25.1	12.0	322.9	33.3	4,912,030	1,232,920	102330	3818	36988
	2021	25.1	12.2	316.6	33.2	5,061,116	1,270,340	104533	4013	38284
	2022	25.1	12.3	310.6	33.0	5,227,882	1,312,198	107102	4225	39717
	2023	25.1	12.3	304.8	32.9	5,387,030	1,352,145	109512	4436	41098
	2024	25.1	12.4	299.3	32.8	5,520,350	1,385,608	111399	4630	42284
	2025	25.1	12.5	294.0	32.6	5,620,021	1,410,625	112617	4799	43215
	2026	25.1	12.6	288.8	32.5	5,685,913	1,427,164	113175	4941	43886
Technical (16-18)		Logarithmic R^2=0.60	*	Power R^2=0.52	Growth R^2=0.50					
	2014	35.5	10.9	807.9	32.9	4,864,690	1,728,650	158156	2140	52470
	2015	35.2	10.9	799.5	32.6	4,815,117	1,692,536	154852	2117	51974
	2016	34.8	10.9	791.8	32.2	4,782,585	1,663,843	152227	2101	51690
	2017	34.4	10.9	784.5	31.8	4,761,760	1,640,397	150082	2091	51557
	2018	34.1	10.9	777.7	31.4	4,762,335	1,625,268	148698	2090	51679
	2019	33.8	10.9	771.2	31.1	4,808,186	1,626,236	148786	2109	52314
	2020	33.5	10.9	765.2	30.7	4,912,030	1,647,093	150695	2153	53604
	2021	33.3	10.9	759.5	30.4	5,061,116	1,683,070	153986	2216	55415
	2022	33.0	10.9	754.0	30.0	5,227,882	1,724,695	157795	2287	57450
	2023	32.7	10.9	748.9	29.7	5,387,030	1,763,551	161350	2355	59430
	2024	32.5	10.9	743.9	29.3	5,520,350	1,793,783	164116	2411	61156
	2025	32.3	10.9	739.3	29.0	5,620,021	1,813,049	165878	2453	62535
	2026	32.0	10.9	734.8	28.7	5,685,913	1,821,533	166654	2479	63562
Azhar(16-18)		S R^2=0.67	Growth R^2=0.57	Logarithmic R^2=0.90	Logarithmic R^2=0.45					
	2014	5.4	8.8	134.8	25.3	4,864,690	262,843	30039	1949	10385
	2015	5.4	9.0	132.0	25.2	4,815,117	258,646	28879	1959	10277
	2016	5.3	9.2	129.4	25.0	4,782,585	255,575	27879	1975	10209
	2017	5.3	9.4	126.9	24.9	4,761,760	253,297	26995	1996	10169
	2018	5.3	9.6	124.5	24.8	4,762,335	252,289	26268	2026	10177
	2019	5.3	9.8	122.3	24.7	4,808,186	253,777	25815	2075	10284
	2020	5.3	10.1	120.1	24.6	4,912,030	258,392	25680	2151	10517
	2021	5.2	10.3	118.1	24.5	5,061,116	265,427	25772	2247	10848
	2022	5.2	10.5	116.2	24.4	5,227,882	273,412	25936	2354	11220
	2023	5.2	10.8	114.3	24.3	5,387,030	281,020	26044	2458	11576
	2024	5.2	11.0	112.5	24.2	5,520,350	287,301	26014	2553	11879
	2025	5.2	11.3	110.8	24.1	5,620,021	291,857	25818	2634	12111
	2026	5.2	11.6	109.2	24.0	5,685,913	294,688	25468	2700	12271

Source: Estimated by Researcher
* Estimated based on median and it assumed to be constant during the (2014-2026)

7.3. Secondary Education in Egypt during the Time Period (2000-2026):

7.3.1. Situation of Secondary Education during the Time Period (2000-2012):

Table(12) presents the trend of number of schools, classes, students and gross enrolment ratio during the time period (2000-2012) for secondary education (public - technical - azhar). Technical secondary has the higher student per school ratio compared with public and Azhar. Azhar secondary almost has the lowest student per class ratio.

Table(12):Number of Schools, Classes, Students (per 1000)and Gross Enrolment for Secondary during The Time Period (2000-2012).

Year	Secondary (Public)			Secondary (Technical)			Secondary(Azhar)			Gross Enrolment Rate			Public Student per			Technical Student per			Azhar Student per		
	Schools	Classes	Students	Schools	Classes	Students	Schools	Classes	Students	Public **	Technical *	Azhar **	Schools	Classes	Teacher	Schools	Classes	Teacher	Schools	Classes	Teacher
2000	1661	26652	1088	1882	55130	2051	1158	9863	299	24.2	46	6.7	654.7	40.8	--	1090.0	37.2	--	258.6	30.4	--
2001	1783	28078	1163	1940	56646	2149	1267	9031	280	25.3	46.9	6.1	652.2	41.4	13.3	1107.9	37.9	--	221.0	31.0	--
2002	1942	29860	1250	1959	57623	2214	1373	9651	286	26.7	48.1	6.1	643.5	41.9	13.7	1130.2	38.4	--	208.2	29.6	7.4
2003	2081	31058	1273	1933	56947	2199	1356	9478	276	26.6	48.9	5.8	611.6	41.0	--	1137.9	38.6	--	203.6	29.1	--
2004	2170	32191	1299	1868	54490	2090	1568	9901	276	26.6	47	5.7	598.7	40.4	13.0	1118.8	38.4	--	175.8	27.8	6.8
2005	2239	32152	1239	1810	51587	1981	1669	10163	280	24.9	44.2	5.6	553.5	38.5	12.3	1094.6	38.4	--	167.7	27.5	8.6
2006	2291	31709	1174	1801	48339	1794	1743	11015	282	23.1	40.8	5.6	512.4	37.0	11.7	995.9	37.1	--	162.1	25.6	7.7
2007	2284	23956	785	1792	39258	1362	1829	10783	279	15.1	45.2	5.4	343.5	32.8	8.5	759.8	34.7	--	152.7	25.9	7.6
2008	2332	24368	798	1790	36762	1252	1943	11138	278	15.1	34.4	5.3	342.1	32.7	--	699.7	34.1	8.4	143.3	25.0	7.6
2009	2414	27750	862	1801	40168	1261	1999	11952	278	15.9	35.3	5.1	357.1	31.1	--	700.1	31.4	8.8	139.0	23.2	--
2010	2632	33596	723	1829	45963	1607	2048	11948	305	13	34.5	5.5	274.8	21.5	--	878.7	35.0	10.9	148.8	25.5	--
2011	2780	35177	1324	1829	48183	1628	2068	11899	339	23.4	35.5	6	476.4	37.7	13.7	890.2	33.8	12.2	164.1	28.5	9
2012	2874	36913	1390	1929	46939	1687	2119	12264	3411				483.7	37.7	13.6	874.5	35.9	11.5	161.0	27.8	9.2

Source: CAPMAS(2013) Statistical Year Book.
***CAPMAS(2014) Social indicators, http://www.capmas.gov.eg/pages_ar.aspx?pageid=802, last accessed 21/11/2014**
**** Calculated by Researcher**

7.2.2. Number of Required Schools, Classes, Teachers for Preparatory Education during the Time Period (2014-2026) under Medium Scenario of Fertility:

Table (11) presents that in 2026, the number schools of public preparatory equal 1.1 times the number of schools in 2012, the number of classrooms equal 1.1 times the number of classrooms in 2012, and the number of teachers equal almost 0.97 times the number of teachers in 2012. Concerning Azhar preparatory, the number of schools in 2026 equal 1.4 times the number of schools in 2012 and the number of classrooms in 2026 equal 1.3 times the number of classrooms in 2012,and the number of teachers in 2026 equal 1.08 times the number of teachers in 2012.

Table(11): Number of the Required Schools, Classes, Teachers for Preparatory Education during the Time Period (2014-2026) under Medium Scenario of Fertility.

Year	School Enrolment Rate	Students per Teacher	Students per School	Students per Classroom	Projected Population (13-15)	Students	Required Teachers	Required Schools	Required Classrooms
				Public					
	Growth R^2=0.60	N.S.*	Inverse R^2=0.54	logarithmic R^2=0.45					
2014	80.5	9.3	381.7	38.7	4,766,356	3,836,733	411257	10051	99038
2015	79.8	9.3	380.7	38.6	4,766,770	3,805,605	407920	9996	98540
2016	79.2	9.3	379.8	38.5	4,812,529	3,810,635	408459	10032	98960
2017	78.5	9.3	379.1	38.4	4,916,328	3,860,906	413848	10185	100544
2018	77.9	9.3	378.4	38.3	5,065,403	3,945,362	422901	10427	103013
2019	77.2	9.3	377.7	38.2	5,232,165	4,041,837	433242	10700	105796
2020	76.6	9.3	377.2	38.1	5,391,294	4,130,616	442758	10952	108378
2021	76.0	9.3	376.6	38.0	5,524,567	4,198,020	449983	11146	110398
2022	75.4	9.3	376.2	37.9	5,624,158	4,238,657	454339	11268	111710
2023	74.7	9.3	375.7	37.9	5,689,940	4,253,074	455884	11320	112325
2024	74.1	9.3	375.3	37.8	5,723,236	4,242,886	454792	11304	112281
2025	73.5	9.3	375.0	37.7	5,736,460	4,217,821	452105	11249	111834
2026	72.9	9.3	374.6	37.6	5,739,183	4,185,223	448611	11172	111177
				Azhar					
	Power R^2=0.41	Logarithmic R^2=0.78	Inverse R^2=0.36	N.S*					
2014	9.51	11.3	138.5	30.6	4,766,356	453,266	40125	3272	14813
2015	9.60	11.4	138.4	30.6	4,766,770	457,774	40013	3307	14960
2016	9.69	11.6	138.3	30.6	4,812,529	466,446	40294	3372	15243
2017	9.78	11.7	138.3	30.6	4,916,328	480,664	41069	3477	15708
2018	9.86	11.8	138.2	30.6	5,065,403	499,326	42227	3614	16318
2019	9.93	11.9	138.1	30.6	5,232,165	519,801	43537	3764	16987
2020	10.01	12.0	138.1	30.6	5,391,294	539,597	44785	3909	17634
2021	10.08	12.2	138.0	30.6	5,524,567	556,859	45823	4035	18198
2022	10.15	12.3	137.9	30.6	5,624,158	570,740	46584	4137	18652
2023	10.21	12.3	137.9	30.6	5,689,940	581,163	47069	4214	18992
2024	10.28	12.4	137.9	30.6	5,723,236	588,202	47290	4267	19222
2025	10.34	12.5	137.8	30.6	5,736,460	593,086	47349	4303	19382
2026	10.40	12.6	137.8	30.6	5,739,183	596,780	47325	4331	19503

Source: Estimated by Researcher
N.S not significant i.e (P value ≥0.05)
* Estimated based on median and it assumed to be constant during the (2014-2026)

Annual Conference on Statistics, Computer Sciences and Operations Research, ISSR, Cairo University, 22-23 Dec. 2014

7.2. Preparatory Education in Egypt during the Time Period (2000-2026):

7.2.1. Situation of Preparatory Education during the Time Period (2000-2012):

Table(10) shows that the ratio of students per school, students per classroom, and students per teachers fluctuated from (2000 to 2012) in preparatory (public –Azhar). Public has higher students per school and students per class ratio compared with Azhar .

Table(10):Number of Schools, Classes, Students and Gross Enrolment for Preparatory during The Time Period (2000-2012).

Year	Preparatory (Public)						Preparatory (Azhar)						Population in Preparatory Age	Gross Enrolment		
	Schools	Classes	Students	Students Per School	Students Per Class	Students Per Teacher	Institute	Classes	Students	Students Per School	Students Per Class	Students Per Teacher		Total *	Public **	Azhar **
2000	7772	100884	4427944	569.7	43.9	–	1946	10035	322332	165.6	32.1	–	4968908	95.6	89.1	6.49
2001	7993	101004	4393211	549.6	43.5	12.3	2091	10209	313265	149.8	30.7	–	4783004	98.4	91.9	6.55
2002	8252	100698	4268319	517.2	42.4	11.7	2230	10585	324209	145.4	30.6	8.4	4768980	96.3	89.5	6.80
2003	8597	100183	4183587	486.6	41.8	–	2355	11038	333430	141.6	30.2	–	4744766	95.2	88.2	7.03
2004	8757	73725	2889212	329.9	39.2	7.6	2452	10745	329708	134.5	30.7	8.2	3479914	92.5	83.0	9.47
2005	8958	73362	2811127	313.8	38.3	7.3	2551	10932	332962	130.5	30.5	9.2	3251385	96.7	86.5	10.24
2006	9146	75030	2878042	314.7	38.4	7.5	2656	11246	339446	127.8	30.2	8.9	3211066	100.2	89.6	10.57
2007	9440	93189	3781251	400.6	40.6	10	2808	12589	366356	130.5	29.1	9.6	4862376	85.3	77.8	7.53
2008	9655	95885	3964948	410.7	41.4	–	2933	13505	402150	137.1	29.8	10.5	5424966	80.5	73.1	7.41
2009	9854	110760	4041072	410.1	36.5	–	3024	15691	433064	143.2	27.6	–	5516814	81.1	73.3	7.85
2010	10113	103018	4153142	410.7	40.3	–	3101	14806	468491	151.1	31.6	–	5028980	91.9	82.6	9.32
2011	10372	103501	4158845	401.0	40.2	9.4	3131	15051	484594	154.8	32.2	11.6	5041736	92.1	82.5	9.61
2012	10608	105077	4279909	403.5	40.7	9.3	3201	14861	473701	148.0	31.9	10.8				

Source: CAPMAS(2013) Statistical Year Book.
*CAPMAS(2014) Social indicators, http://www.capmas.gov.eg/pages_ar.aspx?pageid=802,last accessed 21/11/2014
**Calculated by Researcher

7.1.2. Number of the Required Schools, Classes, Teachers for Primary Education during the Time Period (2014-2026) under Medium Scenario of Fertility:

Table(9) presents that the number schools of public primary in 2026 equal 1.10 times the number of schools in 2012, the number of classrooms equal 1.44 times the number of classrooms in 2012, and the number of teachers in 2026 equal 1.24 times the number of teachers in 2012. Concerning Azhar primary, the number of schools in 2026 equal 1.4 times the number of schools in 2012, the number of classrooms in 2026 equal 1.5 times the number of classrooms in 2012, and the number of teachers in 2026 equal 1.27 times the number of teachers in 2012.

Table(9): Number of the Required Schools, Classes, Teachers for Primary Education during the Time Period (2014-2026) under Medium Scenario of Fertility.

Year	School Enrolment Rate	Students per Teacher	Students per School	Students per Classroom	Projected Primary age population (6-12)	Students	Required Teachers	Required Schools	Required Classrooms
	Public								
	S R^2=0.58	Power R^2=0.54	Linear R^2=0.80	R^2<25 N.S*					
2014	85.90	27.2	602	42.6	12,210,928	10,489,655	385508	17415	246236
2015	85.87	27.4	613	42.6	12,513,848	10,745,798	392702	17531	252249
2016	85.84	27.5	624	42.6	12,791,741	10,980,753	399169	17610	257764
2017	85.82	27.6	634	42.6	13,016,707	11,170,545	404047	17615	262219
2018	85.79	27.8	645	42.6	13,183,507	11,310,676	407188	17543	265509
2019	85.77	27.9	655	42.6	13,297,014	11,405,326	408760	17404	267731
2020	85.76	28.0	666	42.6	13,367,376	11,463,193	409087	17214	269089
2021	85.74	28.1	677	42.6	13,901,858	11,919,190	423635	17618	279793
2022	85.72	28.2	687	42.6	14,413,683	12,355,795	437452	17982	290042
2023	85.71	28.4	698	42.6	14,908,969	12,778,261	450730	18314	299959
2024	85.70	28.5	708	42.6	15,384,029	13,183,428	463367	18612	309470
2025	85.68	28.5	719	42.6	15,837,862	13,570,441	475338	18876	318555
2026	85.67	28.6	730	42.6	16,255,410	13,926,405	486202	19090	326911
	Azhar								
	Quadratic R^2=0.83	*	Lograthmic R^2=0.77	Lograthmic R^2=0.57					
2014	11.5	21.4	358	36.3	12,210,928	1,402,622	65543	3916	38681
2015	11.6	21.4	361	36.4	12,513,848	1,447,718	67650	4012	39771
2016	11.6	21.4	363	36.5	12,791,741	1,488,685	69565	4097	40749
2017	11.7	21.4	366	36.7	13,016,707	1,522,097	71126	4162	41523
2018	11.7	21.4	368	36.8	13,183,507	1,547,158	72297	4205	42071
2019	11.8	21.4	370	36.9	13,297,014	1,564,306	73098	4228	42409
2020	11.8	21.4	372	37.0	13,367,376	1,574,639	73581	4233	42567
2021	11.8	21.4	374	37.1	13,901,858	1,637,878	76536	4380	44156
2022	11.8	21.4	376	37.2	14,413,683	1,696,538	79277	4515	45618
2023	11.7	21.4	377	37.3	14,908,969	1,751,140	81829	4639	46970
2024	11.7	21.4	379	37.4	15,384,029	1,801,068	84162	4750	48194
2025	11.7	21.4	381	37.5	15,837,862	1,846,036	86263	4848	49285
2026	11.59	21.4	382	37.5	16,255,410	1,884,150	88044	4928	50193

Source: Estimated by Researcher
N.S not significant i.e (P value ≥0.05)
* Estimated based on median and it assumed to be constant during the (2014-2026)

7. Requirements of Education System:

The study will present the situation of primary, preparatory, and secondary education in Egypt. The study will use the predicted trend of students per school, per class and per teacher (based on curve fitting(p value<0.05) & R^2) for each education category to estimate the number of required schools, classes, and teachers for each educational stage under the medium scenario of fertility (reasonable scenario).

7.1 Primary Education in Egypt during the Time Period (2000-2026):

7.1.1. Situation of Primary Education during the Time Period (2000-2012):

Table(8) presents the trend of number of schools, classes, and students and gross enrolment ratio during the time period (2000-2012) for primary public and Azhar education. public primary has the higher student per school and student per class ratio compared with Azhar. Student per class ratio fluctuated over years for both public and Azhar.

Table(8):Number of Schools, Classes, Students and Gross Enrolment for Primary during The Time Period (2000-2012).

Year	Primary_Public						Primary_Azhar						Population in Primary Age	Gross Enrolment		
	Schools	Classes	Students	Studentss Per School	Studentss Per Class	Students Per Teacher	Institute	Classes	Students	Students Per Institute	Studentss Per Class	Students Per Teacher		Total *	Public **	Azhar **
2000	15546	173724	7142127	459.4	41.1	--	2657	22861	698916	263.0	30.6	--	7590555	103.3	94.1	9.2
2001	15653	174451	7141303	456.2	40.9	22.5	2736	23582	726058	265.4	30.8	--	8003419	98.3	89.2	9.1
2002	15946	175455	7165620	449.4	40.8	22.2	2822	24013	763113	270.4	31.8	18.7	8140383	97.4	88.0	9.4
2003	16159	176621	7214826	446.5	40.8	--	2901	25112	821217	283.1	32.7	--	8336144	96.4	86.5	9.9
2004	16369	203676	8634115	527.5	42.4	25.6	2983	26741	926081	310.5	34.6	21.2	10021170	95.4	86.2	9.2
2005	16412	205389	8784289	535.2	42.8	26	3090	28411	1010302	327.0	35.6	22	10202699	96	86.1	9.9
2006	16564	207232	8882797	536.3	42.9	26.8	3191	30060	1100026	344.7	36.6	22.3	10334185	96.6	86.0	10.6
2007	16720	209340	9051032	541.3	43.2	27.4	3222	31348	1148101	356.3	36.6	23.2	10713375	95.2	84.5	10.7
2008	16866	212084	9207323	545.9	43.4	--	3355	32455	1199864	357.6	37.0	21.7	10840820	96	84.9	11.1
2009	16951	242676	9334322	550.7	38.5	--	3423	36781	1205712	352.2	32.8	--	11025140	95.6	84.7	10.9
2010	17111	223301	9506363	555.6	42.6	--	3451	33559	1192922	345.7	35.5	--	10572416	101.2	89.9	11.3
2011	17249	223917	9644456	559.1	43.1	25.6	3465	33457	1158721	334.4	34.6	17.1	10792385	100.1	89.4	10.7
2012	17399	227153	9832516	565.1	43.3	25.2	3514	33118	1148524	326.8	34.7	16.6				

Source: CAPMAS(2013) Statistical Year Book.
*CAPMAS(2014) Social indicators, http://www.capmas.gov.eg/pages_ar.aspx?pageid=802,last accessed 21/11/2014
** Calculated by Researcher

Table(7) Projected Labour Force by Sex and Age Group during the Time Period (2014-2026).

Year	Age group	LF		Total
		Male	Female	
2014	15-	922	307	1229
	20-	6153	2307	8460
	30-	5901	1569	7469
	40-	4360	1035	5395
	50-	3027	800	3827
	60+	903	285	1188
	Total	21266	6302	27569
2015	15-	888	296	1184
	20-	6108	2404	8512
	30-	6170	1704	7874
	40-	4427	1064	5491
	50-	3114	858	3972
	60+	911	316	1227
	Total	21617	6641	28259
2016	15-	856	286	1143
	20-	6030	2488	8518
	30-	6456	1850	8306
	40-	4497	1094	5591
	50-	3198	916	4114
	60+	915	349	1264
	Total	21952	6983	28935
2017	15-	833	278	1111
	20-	5927	2527	8454
	30-	6746	1991	8737
	40-	4578	1153	5730
	50-	3270	975	4245
	60+	941	384	1325
	Total	22295	7308	29603
2018	15-	815	272	1087
	20-	5810	2559	8368
	30-	7024	2133	9158
	40-	4679	1218	5896
	50-	3337	1034	4371
	60+	967	421	1388
	Total	22631	7636	30268
2019	15-	803	268	1071
	20-	5687	2586	8273
	30-	7277	2272	9549
	40-	4806	1292	6098
	50-	3398	1093	4491
	60+	992	460	1452
	Total	22962	7970	30933
2020	15-	797	266	1062
	20-	5560	2611	8170
	30-	7501	2405	9906
	40-	4961	1376	6336
	50-	3454	1151	4606
	60+	1016	501	1517
	Total	23288	8309	31597
2021	15-	795	265	1060
	20-	5431	2632	8064
	30-	7696	2531	10227
	40-	5141	1469	6610
	50-	3507	1210	4717
	60+	1038	545	1583
	Total	23609	8653	32262
2022	15-	795	265	1060
	20-	5311	2657	7968
	30-	7855	2649	10504
	40-	5347	1574	6920
	50-	3557	1269	4826
	60+	1060	591	1651
	Total	23925	9004	32929
2023	15-	794	265	1058
	20-	5211	2689	7900
	30-	7972	2755	10727
	40-	5578	1688	7266
	50-	3605	1328	4934
	60+	1081	639	1720
	Total	24240	9365	33605
2024	15-	788	263	1051
	20-	5139	2734	7873
	30-	8043	2847	10890
	40-	5832	1814	7646
	50-	3654	1389	5043
	60+	1099	690	1789
	Total	24555	9737	34292
2025	15-	777	259	1036
	20-	5095	2795	7890
	30-	8066	2924	10990
	40-	6109	1951	8060
	50-	3703	1452	5155
	60+	1117	742	1859
	Total	24867	10123	34989
2026	15-	760	254	1014
	20-	5078	2871	7948
	30-	8046	2985	11031
	40-	6404	2097	8501
	50-	3754	1516	5271
	60+	1132	797	1929
	Total	25175	10520	35695

Source: Estimated by Researcher

As shown from table (6) that all age specific activity rate among females will have an increasing trend from 2006 to 2026 but at different paces except age group (15-19). For instance, activity rate among females aged 20-29 years old will increase from 19% in 2006 to 29.6% in 2016 and continue increasing until reach 36.20% in 2026. Females aged (15-19) has the lowest activity rate followed by elder females while females aged (20-29) have the highest rate of activity during the period (2006-2026).

Table(6): Predicted Age Specific Activity Rates for Females During the Time Period (2006-2026).

Age group / Year	15-19	20-29	30-39	40-49	50-59	60+
2006	9.2	19	18	21	16	5.7
2007	9.0	20.1	19.0	21.3	16.9	6.1
2008	8.8	21.1	19.9	21.5	17.8	6.6
2009	8.7	22.2	20.9	21.8	18.7	7.0
2010	8.5	23.3	21.9	22.1	19.6	7.4
2011	8.3	24.3	22.9	22.3	20.5	7.9
2012	8.1	25.4	23.8	22.6	21.3	8.3
2013	7.9	26.5	24.8	22.9	22.2	8.7
2014	7.8	27.5	25.8	23.1	23.1	9.1
2015	7.6	28.6	26.7	23.4	24.0	9.6
2016	7.4	29.65	27.7	23.66	24.9	10

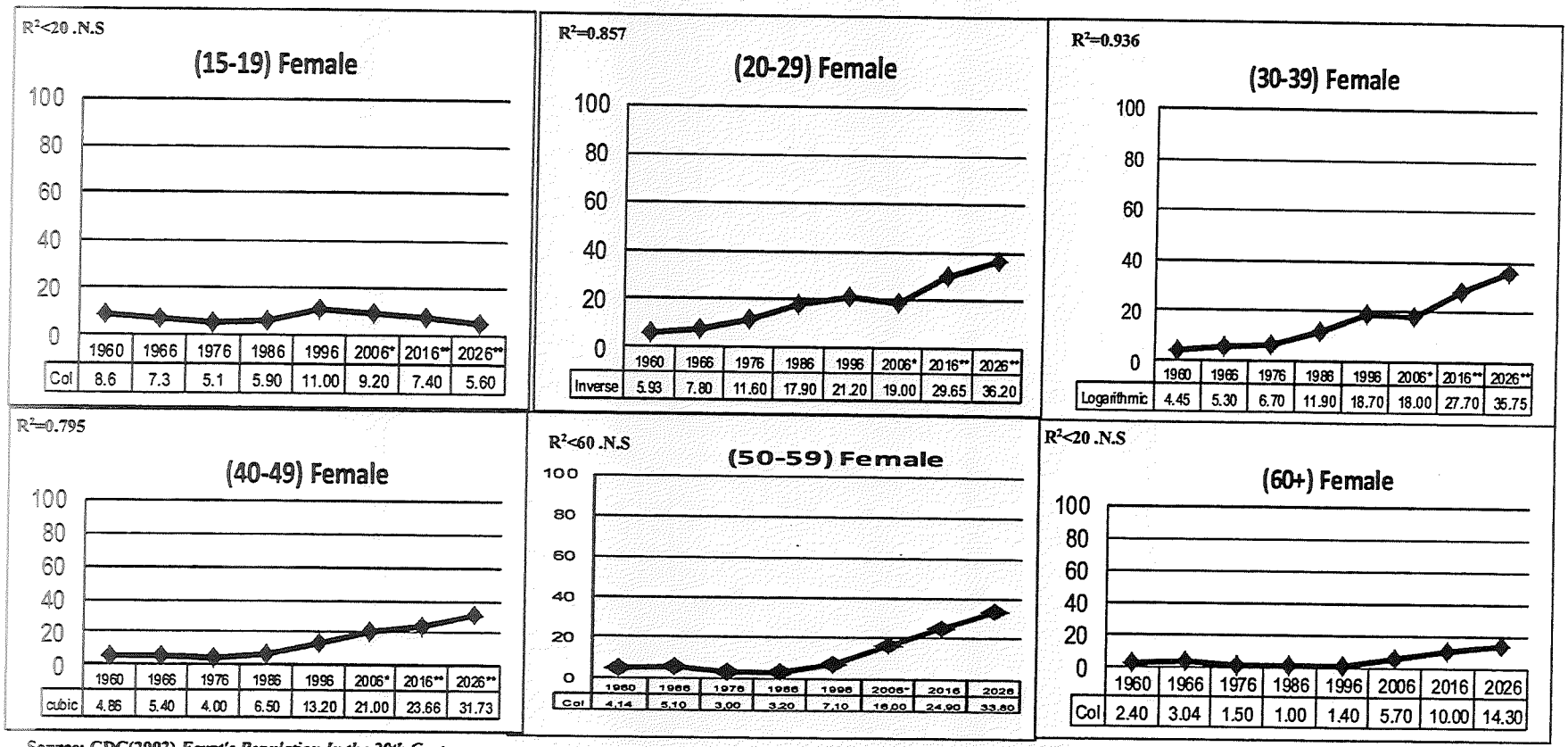
Age group / Year	15-19	20-29	30-39	40-49	50-59	60+
2017	7.2	30.3	28.5	24.5	25.8	10.4
2018	7.0	31.0	29.3	25.3	26.7	10.9
2019	6.9	31.6	30.1	26.1	27.6	11.3
2020	6.7	32.3	30.9	26.9	28.5	11.7
2021	6.5	32.9	31.7	27.7	29.4	12.2
2022	6.3	33.6	32.5	28.5	30.2	12.6
2023	6.1	34.2	33.3	29.3	31.1	13.0
2024	6.0	34.9	34.1	30.1	32.0	13.4
2025	5.8	35.6	34.9	30.9	32.9	13.9
2026	5.6	36.2	35.75	31.73	33.8	14.3

Source: Estimated by Researcher.

6.2.3. Projected Labour Force :

In this section, labour force can be obtained by multiplying the estimated age and sex specific activity rates by the corresponding projected population during the time period (2014-2026) under one scenario, due to all three scenario have the same projected age structure (15+) because projection duration less than 15 years. Table(7) indicates that over the projection period, the labor force will grow from about 27,569 million in 2014 to about 35,695 million in 2026. Female labour force will increase from 6,302 million in 2014 to be 10,520 million in 2026. Age (15-19) has the lowest share of labour force while age (20-29) and age (30-39) have the highest share of labour force in 2026 under all the three proposed fertility scenarios. Male labour force will grow from 21,266 million in 2014 to about 25,175 million in 2026.

Figure(4): Age Specific Activity Rates for Females during the Time Period (1960-2026).



Source: CDC(2003) *Egypt's Population In the 20th Century*

* Calculated by Researcher based on Census 2006.

** Predicted observation from best fitted model(P value <0.05).

N.S. Not significant i.e (P value≥0.05)

For non-significant model for Female ages (15-19), (50-59)and (60+). The researcher assumed that magnitude between 1996 and 2006 will be applied to the other two time points (2006 – 2016), and (2016-2026)

It is concluded from table (5) that all age specific activity rate among males will have a decreasing trend from 2006 to 2026 but at different paces. For instance, activity rate among males aged 20-29 years old will decrease from 77% in 2006 to 68.5% in 2016 and continue decreasing until reach 60% in 2026. Males aged (15-19) remain the lowest activity rate followed by elder people while males aged (40-49) have the highest rate of activity during the period (2006-2026), and the least decreasing trend.

Table(5): Predicted Age Specific Activity Rates for Males during the Time Period (2006-2026).

Age group / Year	15-19	20-29	30-39	40-49	50-59	60+
2006	**27**	**77**	**96**	**96**	**88**	**39.8**
2007	26.4	76.2	95.8	95.9	87.8	38.5
2008	25.8	75.3	95.6	95.9	87.7	37.3
2009	25.2	74.5	95.4	95.8	87.5	36.0
2010	24.5	73.6	95.2	95.7	87.4	34.7
2011	23.9	72.8	95.0	95.6	87.2	33.4
2012	23.3	71.9	94.8	95.6	87.0	32.2
2013	22.7	71.1	94.6	95.5	86.9	30.9
2014	22.1	70.2	94.4	95.4	86.7	29.6
2015	21.4	69.4	94.2	95.3	86.6	28.4
2016	**20.82**	**68.5**	**94**	**95.27**	**86.39**	**27.09**

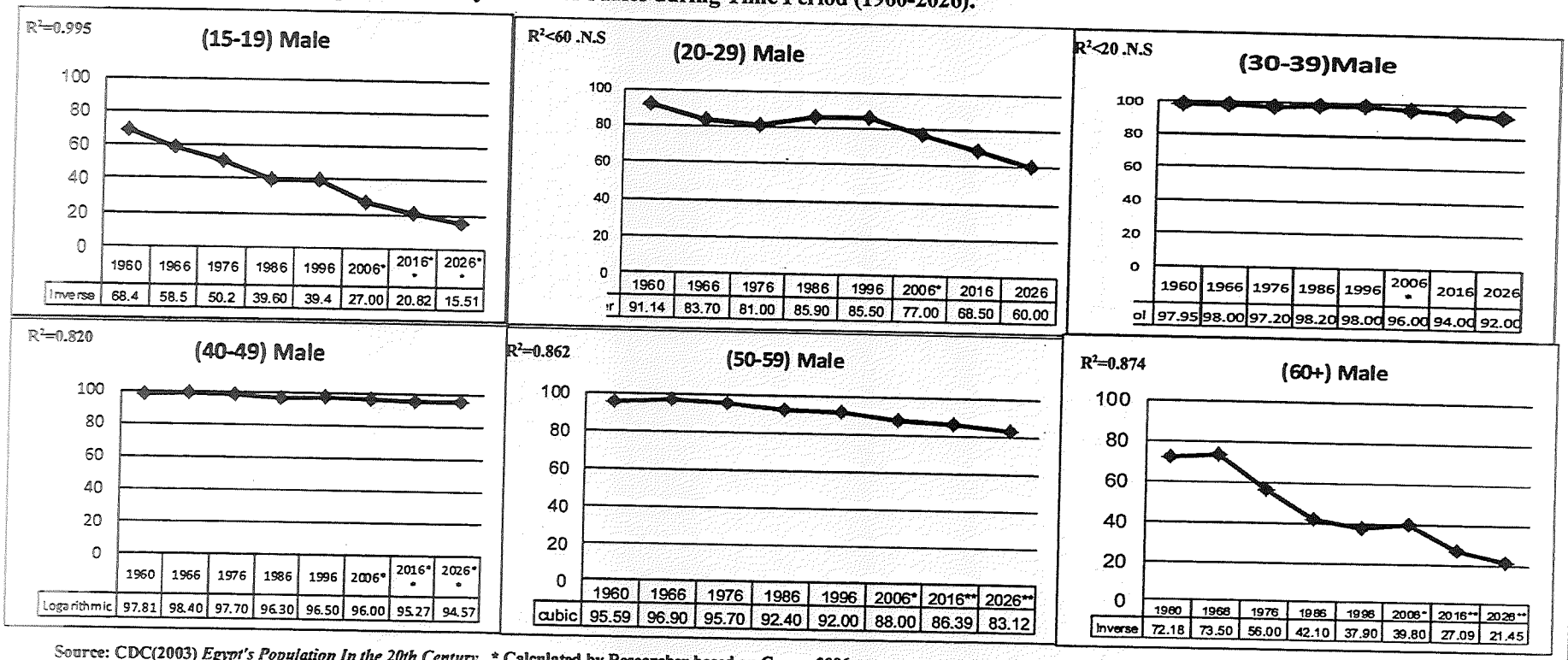
Age group / Year	15-19	20-29	30-39	40-49	50-59	60+
2017	20.3	67.7	93.8	95.2	86.1	26.5
2018	19.8	66.8	93.6	95.1	85.7	26.0
2019	19.2	66.0	93.4	95.1	85.4	25.4
2020	18.7	65.1	93.2	95.0	85.1	24.8
2021	18.2	64.3	93.0	94.9	84.8	24.3
2022	17.6	63.4	92.8	94.9	84.4	23.7
2023	17.1	62.6	92.6	94.8	84.1	23.1
2024	16.6	61.7	92.4	94.7	83.8	22.6
2025	16.0	60.9	92.2	94.6	83.5	22.0
2026	**15.51**	**60**	**92**	**94.57**	**83.12**	**21.45**

Source: Estimated by Researcher.

6.2.2.2. Predicted Age Specific Activity Rates for Females:

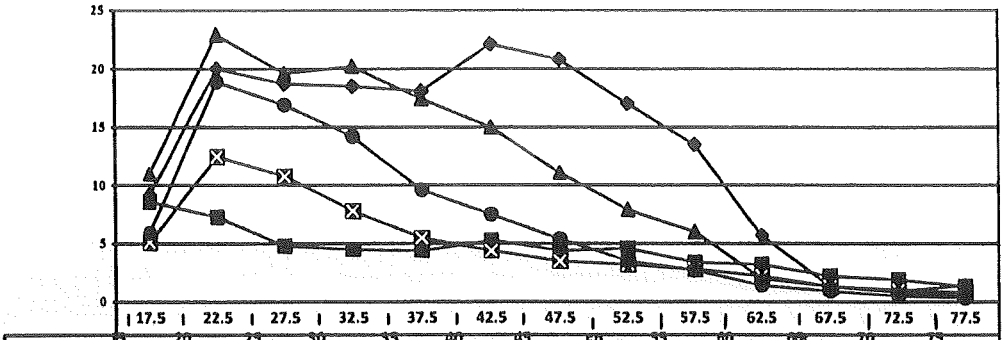
Figure(4) presents the age specific activity rate among females during the time period (1960-2006) based on census data besides two additional predicted time points 2016 and 2026. Almost all ages take an increasing trend but at different pace among females during the time period (1960-2006) and they continue increasing till 2026, except age group (15-19) fluctuated during the time period (1960-1996) but it takes a decreasing trend from 2006 till 2026.

Figure(3): Trend of Age Specific Activity Rates for Males during Time Period (1960-2026).



Source: CDC(2003) *Egypt's Population In the 20th Century* . * Calculated by Researcher based on Census 2006.
** Predicted observation from best fitted model (P value<0.05).
N.S. Not significant i.e (P value≥0.05)
For non-significant model for male ages (20-29), (30-39). The researcher assumed that magnitude between 1996 and 2006 will be applied to the other two time points (2006 – 2016), and (2016-2026)

Figure(2): Trend of Females Age Specific Activity Rates , Egypt Censuses' (1960-2006)



	17.5	22.5	27.5	32.5	37.5	42.5	47.5	52.5	57.5	62.5	67.5	72.5	77.5
1960	8.6	7.3	4.8	4.5	4.4	5.3	4.4	4.6	3.4	3.2	2.2	1.9	1.3
1976	5.1	12.5	10.8	7.8	5.5	4.4	3.5	3.2	2.8	2.2	1.3	1	0.8
1986	5.9	18.9	16.9	14.2	9.6	7.5	5.4	3.5	2.7	1.4	0.9	0.5	0.3
1996	11	22.9	19.6	20.2	17.4	15	11.1	7.9	6	2	1.3	0.9	1.4
2006*	9.2	20	18.7	18.5	18.1	22.1	20.8	17	13.5	5.7	1.3	0.8	0.6

Source: CDC(2003) *Egypt's Population In the 20th Century*, CAPMAS(2008) Final Results of Population, Housing & Establishment 2006 Census. *Calculated by Researcher.

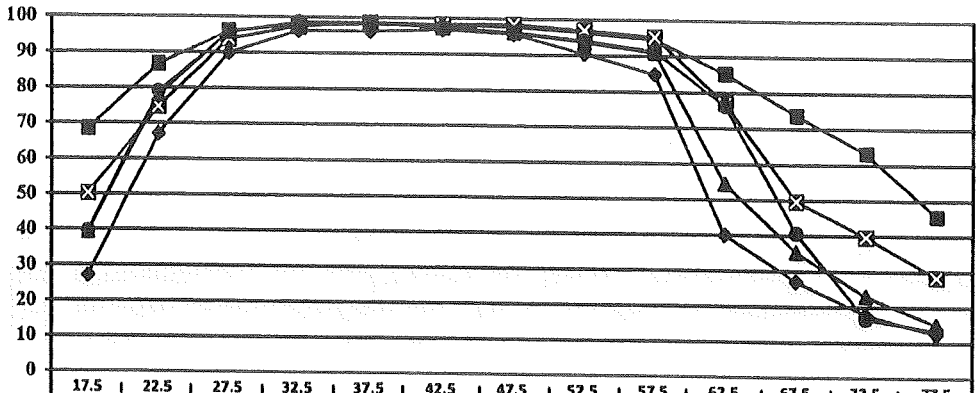
6.2.2. Age Specific Activity Rates by Sex and Age Group (2006-2026):

In order to ensure realistic estimates of labor force participation rates, a logistic transformation is applied to avoid out of range predictions, the final input set of labor force participation rates is transformed logistically in the following manner prior to the estimation procedure: $Y_t=\ln[y_t/(100-y_t)]$. where y_t is the observed labor force participation rate by sex and age in t (ILO,2011). Curve estimation performed based on age specific activity rates from censuses (1960-2006) and the best model that fit the data of age specific activity rate for each age group was chosen (based on its shape & R squared(P value<0.05)) and then we predicted age specific activity rates by sex for two additional time points 2016 and 2026. The gap between them was fulfilled using linear interpolation and the results as follows.

6.2.2.1. Predicted Age Specific Activity Rates for Males:

Figure(3) shows the age specific activity rate among males during the time period (1960-2006) based on census data besides two additional predicted time points 2016 and 2026.

Figure(1): Trend of Males Age Specific Activity Rates , Egypt Censuses' (1960-2006).



	15	20	25	30	35	40	45	50	55	60	65	70	75
1960	68.4	86.6	96	97.8	98.1	97.9	97.7	96.3	94.5	85.2	73.7	63.2	45.5
1976	50.2	74.6	93.8	97.4	98.6	98.2	98.5	97	95.3	76.9	49.6	39.7	28.4
1986	39.6	78.9	95.6	98.6	98.6	97.3	96.2	94.1	91.3	76.1	40.6	16.6	13.3
1996	39.4	77.9	95.8	98.1	98.4	97.3	96.1	93.6	90.8	54.4	35.3	23	15
2006*	27.1	67	89.9	96.2	96.1	96.7	95.7	90.4	84.9	40	27.1	17.7	12.4

Source: CDC(2003) *Egypt's Population In the 20th Century*, CAPMAS(2008) Final Results of Population, Housing & Establishment 2006 Census. *Calculated by Researcher.

B. Age Specific Activity Rates for Females:

It is concluded from figure (2) that the curve of age specific activity rate shifted forward over years, this means that there is a delay in the age of first entry to work. Onset, there was sharp increase in activity rate for younger age (15-19) until reach its peak value. The peak of age specific activity rate varies over years, then after that as age increase they became less motivate to enter labour force age due to marriage and getting pregnant, they have a decreasing trend but at different pace after 1960 till 2006 (while in 2006 they started to return to activity after achieving their fertility goals and then they have a decreasing trend after that) and at their late ages ((30-39)- (40-49)) after that they became more likely to retire or leave labour force. The gap between 1996 and 2006 was bigger for age group(40-44) to (55-59) in favour to 2006 and the gap between them become trivial after age 65. The lowest activity rate at late age groups (65+) was observed in 1986 while the highest activity rate for late age group (75+) was observed in 1960 and 1986. Aged females became more likely to be retired and leave labour force over years and may be this happens because the change of age of retirement to lesser age.

Table(3): Population Size (per 1000) During the Time Period (2014-2026).

Year	Age	Low			Medium			High		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
	0-14	26976	13990	12986	26976	13990	12986	26976	13990	12986
	15-64	55958	28421	27537	55958	28421	27537	55958	28421	27537
	65+	3826	1885	1940	3826	1885	1940	3826	1885	1940
2014	Total	86760	44297	42463	86760	44297	42463	86760	44297	42463
	0-14	27776	14393	13384	27808	14409	13399	27847	14429	13418
	15-64	57008	28960	28048	57008	28960	28048	57008	28960	28048
	65+	4052	1990	2063	4052	1990	2063	4052	1990	2063
2015	Total	88837	45342	43495	88869	45359	43510	88907	45378	43529
	0-14	28541	14776	13765	28639	14826	13813	28762	14889	13873
	15-64	58033	29487	28546	58033	29487	28546	58033	29487	28546
	65+	4281	2095	2187	4281	2095	2187	4281	2095	2187
2016	Total	90855	46358	44497	90953	46408	44545	91076	46471	44605
	0-14	29249	15130	14119	29448	15232	14216	29697	15360	14338
	15-64	59047	30011	29036	59047	30011	29036	59047	30011	29036
	65+	4517	2204	2313	4517	2204	2313	4517	2204	2313
2017	Total	92813	47345	45468	93012	47447	45565	93261	47574	45687
	0-14	29862	15435	14427	30199	15607	14592	30625	15826	14799
	15-64	60073	30543	29531	60073	30543	29531	60073	30543	29531
	65+	4762	2318	2445	4762	2318	2445	4762	2318	2445
2018	Total	94698	48295	46403	95035	48468	46567	95461	48686	46775
	0-14	30360	15680	14680	30875	15944	14931	31524	16276	15248
	15-64	61126	31090	30037	61126	31090	30037	61126	31090	30037
	65+	5021	2438	2583	5021	2438	2583	5021	2438	2583
2019	Total	96508	49208	47299	97023	49472	47551	97671	49804	47867
	0-14	30729	15859	14871	31457	16231	15225	32382	16706	15677
	15-64	62212	31655	30556	62212	31655	30556	62212	31655	30556
	65+	5293	2566	2727	5293	2566	2727	5293	2566	2727
2020	Total	98234	50080	48154	98961	50453	48509	99887	50927	48960
	0-14	30958	15965	14993	31949	16473	15476	33200	17113	16086
	15-64	63325	32237	31088	63325	32237	31088	63325	32237	31088
	65+	5579	2701	2878	5579	2701	2878	5579	2701	2878
2021	Total	99862	50903	48959	100853	51411	49443	102104	52052	50052
	0-14	31059	16005	15054	32355	16669	15686	33982	17503	16479
	15-64	64460	32831	31628	64460	32831	31628	64460	32831	31628
	65+	5878	2843	3036	5878	2843	3036	5878	2843	3036
2022	Total	101397	51679	49718	102693	52343	50350	104320	53177	51143
	0-14	31035	15981	15054	32677	16823	15854	34740	17880	16860
	15-64	65604	33432	32172	65604	33432	32172	65604	33432	32172
	65+	6188	2990	3199	6188	2990	3199	6188	2990	3199
2023	Total	102828	52403	50425	104470	53245	51225	106533	54302	52231
	0-14	30907	15903	15004	32936	16944	15992	35487	18252	17235
	15-64	66748	34034	32714	66748	34034	32714	66748	34034	32714
	65+	6508	3141	3366	6508	3141	3366	6508	3141	3366
2024	Total	104163	53079	51084	106192	54119	52072	108743	55428	53315
	0-14	30679	15775	14903	33134	17035	16100	36233	18624	17609
	15-64	67882	34632	33250	67882	34632	33250	67882	34632	33250
	65+	6835	3297	3538	6835	3297	3538	6835	3297	3538
2025	Total	105396	53704	51692	107852	54964	52888	110950	56553	54397
	0-14	30372	15607	14765	33294	17106	16187	36989	19002	17987
	15-64	68996	35220	33776	68996	35220	33776	68996	35220	33776
	65+	7169	3457	3712	7169	3457	3712	7169	3457	3712
2026	Total	106538	54284	52253	109459	55783	53676	113154	57679	55476

Source: Estimated by Researcher.

It is concluded from table(4) that dependency ratio will slightly increase from 55% in 2014 to be 58% in low scenario and on the contrary it will increase to 59% and 61% respectively under medium and high scenarios in 2021. And then it will revert to slightly decrease to be 54% in low scenario, while in the medium it will be almost constant, and in the high scenario it will continue to increase slightly until it reach 64%.

Table(4): Trend of Dependency Ratio During the Time Period (2014-2026).

Years	Low	Medium	High
2014	**0.55**	**0.55**	**0.55**
2015	0.56	0.56	0.56
2016	0.57	0.57	0.57
2017	0.57	0.58	0.58
2018	0.58	0.58	0.59
2019	0.58	0.59	0.6
2020	0.58	0.59	0.61
2021	**0.58**	**0.59**	**0.61**
2022	0.57	0.59	0.62
2023	0.57	0.59	0.62
2024	0.56	0.59	0.63
2025	0.55	0.59	0.63
2026	**0.54**	**0.59**	**0.64**

Source: Estimated by Researcher.

6.2. Labour Force Projection:

This section will discuss labour force projection.

6.2.1. Trend of Age Specific Activity Rates by Sex in Egypt:

This subsection interested in exploring age specific activity rates by sex during the time period (1960-2006).

A. Age Specific Activity Rates for Males:

Figure(1) indicates that the highest age specific activity rate is observed among males aged (30-34) & (35-39) relative to other age groups during the time period (1960-2006). The level of activity rate for younger age (10-14) & (15-19) decreased over time. The lowest activity rate among (15-19) was observed in 2006, while the highest activity rate for age greater than 60 was shown in 1960. For age groups (35-39) to age group (55-59), they start to take a decreasing trend during (1976- 2006). The activity rate for late age groups (60+) has a sharp decreasing trend over years, and the year 2006 have the smallest activity rate for age 65 or more. It is found that male age specific activity rates increase until reach its peak, then it start to decrease after age(45-59) but at different pace until ultimate age over years.

But since the crude birth rate started to increase over time after 2005. It increased from 25.7‰ in 2006 to 30.4‰ in 2011[1]and the preliminary report of Egypt Demographic and Health Survey for 2014 denotes that TFR reaches 3.47 child per women in 2014. So, the study will take into consideration this new information when formulating the three suggested scenarios of population projection. The study assumed that life expectancy for females will be slightly increased from 72.5 year in 2014 to be 74.9 in 2026 while the life expectancy for males will increase from 69.7 year in 2014 to be 73.6 in 2026. The study adopted the UN South Asia model life table, neglected the influence of international migration (no migration), and the population projection base year will be 2014.

6.1. Projected Population by Sex and Age Group during (2014-2026):

Table(2) shows that three fertility scenarios during the time period(2014-2026). Total fertility rate will remain constant at 3.47 births per woman from 2014 to 2026 under high scenario, while TFR will decrease by almost 0.07 percentage point annually to reach 2.7 in 2026 under medium scenario, and total fertility rate will reach replacement level 2.1 births in 2026 under low scenario. This study will apply a simple linear interpolation to fill the gap between time points during the period (2014-2026).

Table(2): Trend of Total Fertility Rate During the Time Period (2014-2026).

Years	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Low	3.47	3.36	3.24	3.13	3.01	2.9	2.79	2.67	2.56	2.44	2.33	2.21	2.1
Medium	3.47	3.41	3.34	3.28	3.21	3.15	3.08	3.02	2.96	2.89	2.83	2.76	2.7
High	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47

Source: Estimated by Researcher.

Table (3) presents that even under the low scenario the population will increase to 106,538 million in 2026 compared to 109,459 million person in medium scenario and in the high scenario, the total population will increase to be 113,154 million person in 2026. The proportion of children under 15 was the lowest (29%) in low scenario compared with (30%) in medium and (33%) in high scenario in 2026. As expected, size of elders was higher for females relative to males in all scenarios in 2026. The size of working age population males is higher than the size of working age population for females.

[1] CAPMAS(2013) Statistical Year Book.

Table (1): A brief about Selected Studies on Population and Labour Force Projection.

Studies	Time Period	Main Target	Method	Software Program	Fertility Scenarios
CDC (1994)	1986-2021	Population Projection		FivFiv-SinSin program	(1) First assumption: TFR reach 2.6 child per woman in the time period (2016-2021). (2) Second assumption: TFR reach only 2.2 child per woman in the time period (2016-2021). (3) Third assumption: TFR reach only 2.0 child per woman in during the time period (2016-2021).
CDC (2000)	1996-2021	Population Projection At national & governorate level	a)Cohort Component Method b) Ratio Method (Governorate level)	MORTPAK Spectrum	(4) High variant: TFR will reach 2.1 in 2040. (5) Medium variant: TFR will reach 2.1 in 2030. (6) Low variant: TFR will reach 2.1 in 2020.
POLICY Project (2002)	2000-2017	Population & Labour projection in addition to health and education	Cohort-Component Method	They used three modules in SPECTRUM: (DEMPROJ-FAMPLAN-RAPID)	(1) High variant: TFR will remain constant at its current level 3.5. According to the EDHS2000. (2) Medium variant: TFR will reach 2.1 in the year 2027. (3) Low variant: TFR= 2.1 will reach 2.1 in the year 2017.
Nassar et al (2006)	2005 - 2020	Labour force Projection			They based their analysis on the three scenarios of the policy project projection (1996-2050). (1) First scenario: the current tempo of annual increase of just below 0.5 percentage points will continue until year 2050. So Female labour force participation rate will reach about 39% in 2050. (2) Second scenario: labour force participation rate Will be increased by 50% every 10 years until 2030 and the Female labour force participation rate stalls at around 56% till 2050.
CAPMAS (2009)	2006-2031	Population Projection	Cohort Component Method	MORTPAK Spectrum	(1) High variant: TFR will reach 2.1 in 2031. (2) Medium variant: TFR will reach 2.1 in 2026. (3) Low variant: TFR will reach 2.1 in 2021.
UNDP (2011)	2010-2100	Population Projection	Cohort Component Method	SPECTRUM	(1) High variant: TFR to be decreases from 2.89 (2010-2015) to be 2.38 during the period (2045-2050) (2) Medium variant: TFR to be decreases from 2.64 (2010-2015) to be 1.88 during the period (2045-2050) (3) Low variant: TFR to be decreases from 2.39 (2010-2015) to be 1.38 during the (2045-2050). (4) Constant-fertility variant: to keep TFR be constant (2.85) during the period (2005-2100).
ILO (2011)	Estimation model 1990-2010 Projection model 2011-2020	Labour force participation rates Estimation & projection			They based their analysis on the projections of the total population and its components by sex and age group are produced by the UN Population Division (2010).

6. Population and Labor Force Projections Studies:

Egypt has a long experience in constructing life tables and implementing population projections. Component method used in population projections since fifties and it depends on predicting each of the components of population growth. Makkar has prepared the first population projections using Egypt's census 1947 in 1957 and followed by the second set of population projections performed by the Central Committee of Statistics using 1960 Egypt's census in 1962 (CDC, 2000).

The third set of population projection implemented by Makhlouf, H. using 1966 Egypt's census in 1979. Ahmed, F. in 1983 applied the fourth set of population projection using 1976 census of Egypt then CAPMAS performed population projection using 1986 Egypt's Census. Most of the previous projections used (Makeham's Formula) to predict mortality levels (CAPMAS, 2009). CAPMAS implement population projection at the national and governorate level in 1988 using sample data (20%) from 1986 census then they performed population projection for development purposes at national level using the final results of 1986 census of Egypt in 1994 (CDC, 2000). In 2000, CDC carried out population projection for development goals at national level using Egypt census of 1996. POLICY project provided population and labor force projections in addition to health, and education. Then, CAPMAS performed population projection (2006-2031) based on 2006 census in 2009. Several population studies were interested in population and labor force projecting depending on different techniques for social development planning and for integrating population parameters into development projects and strategies.

In the following table a brief about selected studies performed population and labour force projections according to five dimensions (time period - main target – method used – software or program used – scenarios).

population policies should be convenient to the age structure of population. Based on the new information Total fertility rate (TFR) reached 3.47 in 2014, emerges the need to consider this unexpected figure in building a new population and labour force projection, and on the other side, to give insight about the new expected needs of (schools – classrooms - teachers) according to (public – Azhar - technical) education during the study period.

3. Study Objectives:

The study aims to explore the trend of age specific activity rates by sex over time, gather and construct a data base for population, labor and the requirement of educational needs which will enable the researcher to use them later in assessing the impact of population and labor policy on the performance of economy and vice versa in economy wide model.

4. Methodology:

The study performs the following:

a) Adopt component cohort method to obtain population and labour force projection during time period (2014-2026).

b) Implement curve estimation to estimate and predict age specific activity rates for each sex.

c) Implement curve estimation to estimate Gross enrolment ratio, student per school, and student per class for primary, preparatory, and secondary education.

5. Data Sources:

The study uses different data sources as follows: statistical yearbooks, Egypt in numbers, and population censuses from Central Agency for Public Mobilization and Statistics (CAPMAS) and Demographic and Health Surveys.

1. Introduction:

Improving the quality of living conditions and reducing unemployment are considered the main concern of any policy maker. According to national surveys, Egypt suffers deeply from poverty and unemployment. Based on the national poverty line, the proportion of people below the poverty line increased from 19.6% in 2004/2005 to 21.6% in 2008/2009 and it continues to increase to 25.2% in 2010/2011 and 26.3% in 2012/2013[1]. Level of unemployment increased from 8.95% in 1996 to 9.72 % in 2006 and it continues to increase to be 13.2% in 2013[2]. Average annual population growth rate had slight decrease from 2.08% (1986/1996) to be 2.05% (1996/2006), then began to turnover after 2006, till it reached to 2.43% in 2011[3]. Poverty and unemployment reduction remains a huge challenge for Egypt.

It is very essential to investigate the impact of several population policies or scenarios on labour force and education. This will give the decision-maker means to be capable to adopt the appropriate policy and monitoring the consequences of each policy. Population policies varies across countries. These policies may include (reducing morbidity & mortality and health improvement - fertility – population growth & population age structure - international migration - geographical distribution of the population and internal migration). This paper will focus on fertility scenarios and their implications on labour force and educational needs.

2. Importance of the Study:

Population problem represents pressure on our national economic resources due to the imbalance between population growth and economic growth, causing different aspects of population problems, such as high unemployment rates and low wages which caused variations in the poverty levels. Therefore, we need to identify the impact of population and demographic dimension inside integrated system of development taking in consideration economic development dimension. These

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[2] CAPMAS (2014) Statistical Year book 2014. http://www.capmas.gov.eg/pdf/Electronic%20Static%20Book2014//PDF/labor/Untitled.pdf, last Access 5/12/2014
[3] CAPMAS et al (2012) egyinfo. http://www.egyinfo.net.eg/DI5Web/home.aspx

Population, Labour force and Requirements of Education Needs Projections during the Time Period (2014-2026)

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Abstract:

This study aims to conduct a population, labour force, and educational requirement projections during the period (2014-2026) using different data sources from Central Agency for Public Mobilization and Statistics (CAPMAS) (population censuses, statistical yearbooks), and demographic and health surveys. The findings indicate that even under the low scenario (Total fertility rate (TFR) =2.1 in 2026) the population will increase to 106,538 million person in 2026 compared to 109,459 million person in medium scenario(TFR=2.7 in 2026), and in the high scenario(TFR constant at 3.47 till 2026), the total population will increase to be 113,154 million person in 2026. Female labour force will increase from 6,302 million in 2014 to be 10,520 million in 2026 while male labour force will grow from 21,266 million in 2014 to about 27,175 million in 2026. Concerning educational needs, the number of public primary schools should increase by 10%, the number of classrooms by almost 44% and the number of teachers by 24% during the period(2014-2026), and for Azhar primary, we need to increase the number of schools, the number of classrooms, and the number of teachers by (40%, 50%, 27%) respectively during the same period under the medium scenario of fertility. The same high effect will exist for the requirements of preparatory and secondary education.

Kew words: Population Projection – labour Force – Education Needs.

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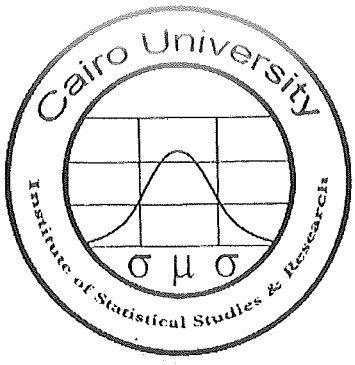
Note: This study is a part of a PHD study of "Population Economy Wide Interaction Simulation Model For Egypt", and this study stressed only on population, labour force and requirements of education needs.

Index
Demography



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